SCIENTIFIC AMERICAN

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LONDON, BERRY & ORTON'S BAND SAW MILL.

Our engraving represents one of the patent band saw mills made by Messrs. London, Berry & Orton, of Philadelphia, Pa.

The general construction of this mill will be readily understood from the engraving. The working parts are all mounted on a single cast iron bed plate, so that the whole mill, down to the carriage driving pinion, is complete and self-contained. The driving belt is governed by an "idler" pulley, which, together with the feed works, is arranged so that the operator, without moving from his position, can stop or start the mill, change the feed instantly from 0 to 50 feet per minute, or change the direction of the log carriage.

These mills are built in various sizes to suit the special needs of users, the largest being capable of sawing logs eight feet in diameter. This machine appears to possess as great advantages over the circular saw mills as the latter have over the ordinary reciprocating saw mill. The kerf made by the band saw is but 1-16th instead of 5-16ths inch, as in the case of the ordinary circular saw. The employment of saws of this thickness effects a considerable saving in lumber, and also in the power required to drive the mill.

Further information may be obtained from London, Berry & Orton, successors to Richards, London & Kelley, Twenty-second street, above Arch, Philadelphia, Pa.

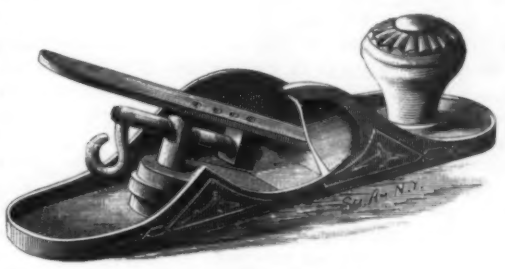
Trade Depression in England.

While our manufacturers are mostly busy, and works that have been idle for some time are brushing up, with the intention of early starting their machinery, our English contemporaries tell a sad tale about their home industries.

Taken all round, says the British *Trade Journal*, there appears to be no improvement in the prospects of trade. Cotton mills, ironworks, collieries, and manufactories of all kinds are nearly all working shorter hours, and not a few have stopped entirely. Cotton goods are reported to have been sold lately at lower prices than have ever been known before. The same might almost be said with regard to iron. Under these circumstances a reduction of wages has been a matter of sheer necessity on the part of the masters. Not infrequently it has been that employers have had to study not how to retain a profit, but how to minimize a loss. Generally speaking the laboring classes have submitted to the inevitable, but in some parts of the country the men have endeavored to hold out against the reductions.

A NEW CARPENTER'S PLANE.

The accompanying engraving shows a new adjusting device for plane bits or irons, recently patented by Mr. L. Bailey, of Hartford, Conn. It is especially designed for metallic planes, and consists in a stud which supports the bit, and is adjustable in a socket that is cast with the body of the plane. A differential screw passes through this stud, and engages a nut having a pin or stud projecting from one



BAILEY'S PLANE.

of its sides, which may be inserted in any of the several holes in the bit. The differential screw has a jointed handle which answers the purpose of a lever, by means of which the bit may be nicely adjusted.

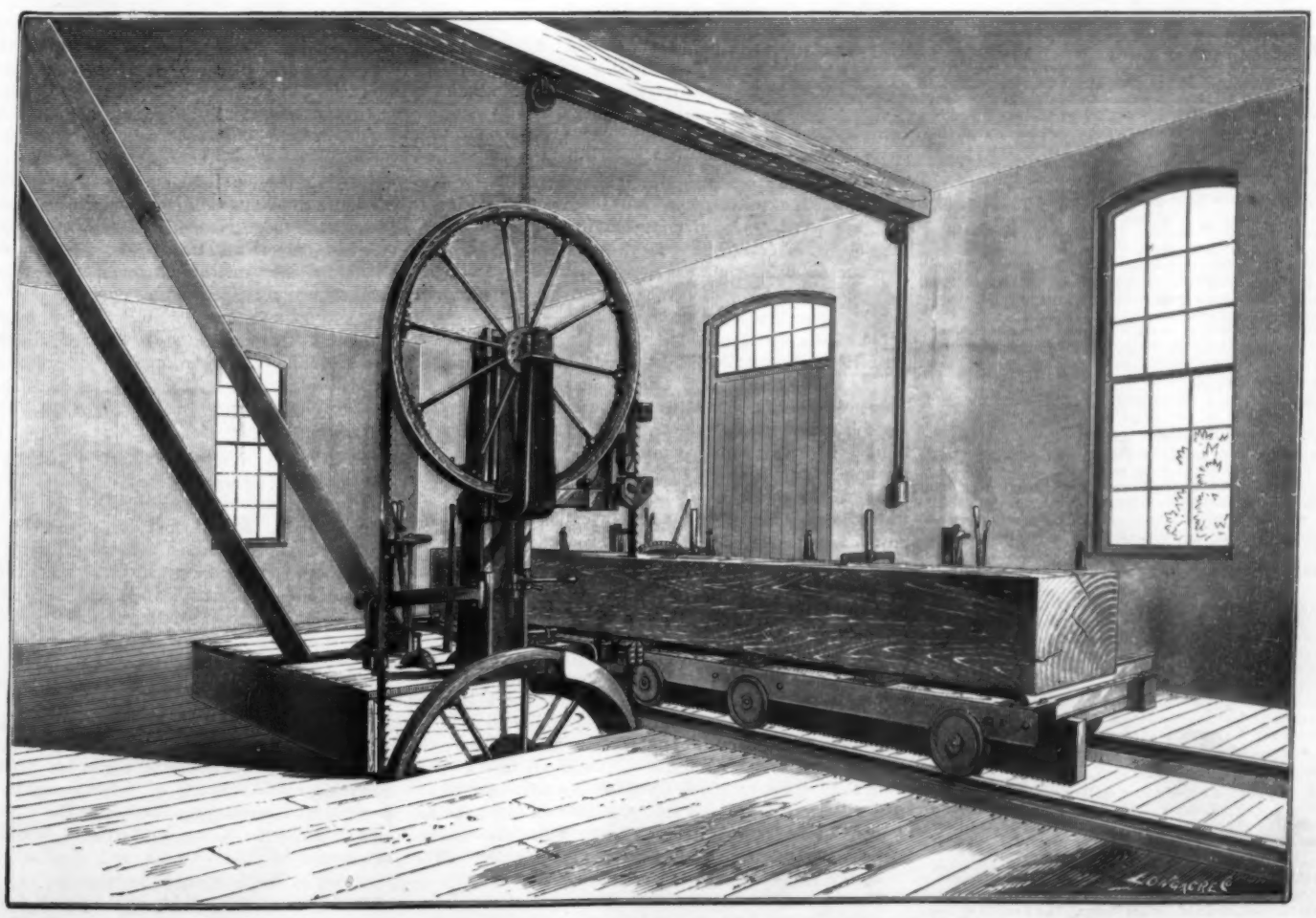
A Practical Application of the Electric Current.

A very important application of the electric current, says the British *Trade Journal*, is now being carried out by Sir William Armstrong on his estate. A volume of water descending at the outfall of a Northumberland lake has been utilized by the interposition of a turbine, by means of which the requisite revolutions are given to a dynamo electric machine. The electric current thus generated is conveyed through a stout copper wire to the private residence of Sir William at Cragside—a distance of about a mile and a half. The current is there conducted through a lamp, in which the regularity of the light is maintained by clockwork, subject to the control of an electro-magnet, which magnet reflects the strength or weakness of the current, so as to regulate the distance between the points of the carbon electrodes. It has been found necessary to provide a second wire to take the return current, so that the first cost of the light is somewhat large, but the working expense is very small. In addition to this use of the electric current as a source of light, Sir W. Armstrong intends to avail himself of the power thus brought into his house by applying it to several domestic purposes. This is to be accomplished by means of an electric engine situated in or near the house, and receiving the current transmitted from the machine at the lake outfall. In this way Sir William will be able to make a more constant use of what may be termed his electrical "plant," and thus may look forward to a satisfactory result in an economical respect. This example of the conversion and transmission of power will be viewed with great interest, the distance of a mile and a half being sufficient to indicate a much more extended sphere of action for the electric current than has hitherto been found practicable.

Toil and be Happy.

The *Christian at Work* thinks Ruskin never said a truer thing than this: "If you want knowledge, you must toil for it; if food, you must toil for it; and if pleasure, you must toil for it." Toil is the law. Pleasure comes through toil, and not by self-indulgence and indolence. When one gets to love work his life is a happy one. Said a poor man in Brooklyn, the other day, with a family of eleven to provide for: "If I were worth a million dollars, I should not wish to do much different than I do now every day, working hour after hour. I love it a thousand times better than to rest." He has for nearly half a century been surrounded by workers, and has caught the spirit of industry. He loves his work better than food or sleep. He is happy who has conquered laziness, once and forever.

A YOUNG man who gets a subordinate situation sometimes thinks it not necessary for him to give it much attention. He will wait until he gets a place of responsibility, and then he will show people what he can do. This is a very great mistake. Whatever his situation may be, he should master it in all its details, and perform all its duties faithfully.



LONDON, BERRY & ORTON'S BAND SAW MILL.

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(Illustrated articles are marked with an asterisk.)

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CONFISCATION OF AMERICAN PATENTS.

Hitherto one of the special features, and, we believe, special merits, of the American patent system has been the issuing of patents for invention without restriction or drawback in the way of after charges or conditions. An inventor applies for a patent, and, if his claim is good, the patent is granted; and there the matter rests for the allotted term of years. The patentee can sell or transfer his right the same as other property. He is not obliged to develop the invention commercially, nor to pay any more fees. If through disinclination or inability the patent is not used, the right to use it is not forfeited. Of course the presumption is that the great mass of patents, if workable, will be worked, and the country will begin to profit thereby without delay. If not, the life of the patent soon expires, and the invention falls into the common stock of knowledge, to be used or neglected as its value may determine.

Our readers are aware that in the proposed amendment of the patent law (Senate Bill 300, section xi.) an attempt is made to abolish this feature of the law. The reasons for so doing are succinctly stated in the report of the Patent Committee submitted to the Senate March 8. We quote:

"One inconvenience of the enormous increase in the number of patents granted is that many of them are for things of inconsiderable practical utility. Such patents are not merely useless, they stand in the way of every future inventor who may wish to make an advantageous use of some little feature which forms an incidental part of them. There are really obstructive patents; the thing they describe is useless in itself; they do not disclose an invention which will be so valuable when the practical difficulties of applying it have been overcome as to lead any one to spend time and money in the endeavor to overcome them; they lie dead and useless, practically abandoned as worthless by their owners. Such patents have no reason for existence, for they neither constitute nor create any progress in the useful arts. Something can be done in instituting a better examination when they are granted, but not much, for attempts at the outset to judge of the degree of future usefulness are found by experience to lead to fatal mistakes. The examination must be confined to the question of novelty.

"Section 11 undertakes to extinguish these worthless patents, by requiring the payment of a fee of $50 when the patent is about four and one half years old, and $100 when it is about nine and one half years old. The sums are large enough to make an owner think twice about paying them for a patent which, after four or nine years' trial, holds out no prospect of usefulness, while at the same time they are not too onerous for patents of any value. The plan is in use in England, and in a modified form on the continent of Europe, and judging from the experience of those countries will probably extinguish one half of the patents granted. It will take hold of just those patents which, useless themselves, reappear in the form of reissues, and cause those annoyances for which the worthlessness of the invention and not the ability to obtain the reissue is really responsible."

This reasoning we hold to be clearly fallacious at several points.

Grant that many patents are of inconsiderable practical utility, shall we therefore rob the inventor of that little because it is small?

How can a patent, or the idea which it covers, be justly called worthless and at the same time desirable to another? A.'s patent is undeveloped and worthless. Why? Because B. wants to use it! "It is naught, it is naught," saith the buyer." Shall the government, therefore, agree with him to the detriment of the owner?

If a patent really lies "dead and useless, practically abandoned as worthless" by its owner, will it be killed any deader by legislative enactment? A patent that is dead through inherent worthlessness is as incompetent of harm as any other worthless bit of paper. If it has life enough to be an object of desire to anybody, there is no reason why the would-be user should not pay for the privilege of owning or using it. There is no danger that he will pay more than he thinks it is really worth to him.

But, it is argued, it is desirable to get out of the way patents that are worthless and yet may be reissued and so become troublesome. Will the reissue of a patent on an inherently worthless invention give it force and vitality?

It sometimes, indeed quite frequently, happens that an invention is "practically" worthless for many years, not through its own demerit, but because the inventor foreruns his time. Financial success implies an immediate demand, which does not always exist for an invention that is radically novel and valuable. The invention, even when unprofitable, may greatly hasten the social or industrial changes which in after years will make it a great public benefit and also a source of profit to the owner. Shall we, therefore, punish the inventor by confiscating his property because he invented too soon? In how many cases is the inventor urged on by the hope of ultimately educating the community up to the use of his invention, though the immediate prospect is black enough, and so is encouraged to make and develop his invention to his own cost through many years? Take away the assurance that his patent once gained will hold his right until the community grows up to the appreciation of it, and you take away one of the strongest inducements to invent. "Even if I die before my reward comes," the inventor says, "the patent will remain as a legacy to my family." Very often it is all he can hope to leave them.

There is another way of looking at this question.

Suppose it true that a certain percentage of the patents issued are at once worthless and a hinderance to the progress of the arts. How large is that percentage? There are in force to-day, say, 100,000 patents; we believe that the actual number is even greater than that. How many of them are a source of "annoyance" through patent litigations and the like? To say one per cent would be a gross exaggeration, and certainly not more than half of these would have fallen under the exterminating influence of the proposed rule had it been in operation.

Accordingly, to get rid of a few patents, alleged to be mischievous, it is proposed to subject the entire class of future patentees to penalties at once uncalled for and unjust. Grant all that is charged against the "worthless" patents, so called; to get rid of them by such means would be paying altogether too much for the whistle.

AMERICAN HISTORY OF THE ELECTRIC LIGHT.

In a recent address before the Academy of Sciences, in this city, Professor Charles A. Seeley read a letter from Professor Moses G. Farmer, of Boston, in which he says that as early as 1859 he lighted up a house in Salem, Mass., by means of the subdivision of the electric light. Instead of using the dynamo-electric machine, he used a battery, and consequently, the cost of the light produced exceeded that obtained from gas. It is a singular fact in conjunction with this that, according to Professor Farmer, the lights thus obtained were turned on or off by means of platinum wires attached to buttons. For nearly a year, the professor alleges, the house in Salem was thus lighted, and that the fact is well known by the residents of Salem, and scientific men who visited the place from other towns and gazed with wonder at the extraordinary brilliancy of the light. Professor Seeley maintains that although the light generated by Professor Farmer by a battery was ascertained to be expensive, now that Siemens, Wallace, and Gramme dynamo-electrical machines have been so much improved, the light can be generated for but a trifle of the cost of carbureted hydrogen gas.

"No doubt," Professor Seeley said, "you think it strange that one electrician says he gets but 300 candle power per horse power from a dynamo-electric machine, while another says he gets 600 candle power per horse power. Probably both averments are correct. The trouble is that one is further advanced in the science than the other. The Messrs. Siemens, the well known English electricians, say that one pound of coal will produce fifteen times more light in connection with a dynamo-electric machine than will be produced by the same amount of coal turned into gas."

THE SOUTH AS A COMPETITOR OF ENGLAND.

Recently an address was delivered in Blackburn, England, before an audience of two or three hundred mill managers, overlookers, and their friends interested in the cotton industry.

The subject under discussion was the chances of England in the matter of foreign competition. After speaking of the natural advantages of the United States for producing cotton and feeding operatives, the lecturer called attention to a fact of infinite importance which is lost sight of by those who consider the power of America to enter into competition with England. "They look simply to the Northern mills, but there is a cotton industry growing up in the Southern States. It is only equal at present to one tenth of the entire United States cotton industry; but the Southern manufacturers claim to have advantage over the Northern manufacturers. They have an abundant supply of water, which is available all the year round, instead of being subject to interruption in the winter owing to frost. They have cotton close to their doors; they have a more favorable climate, and they have equally good ports of shipment, and they can compete with their rivals. If, then, the Northern mills are already entering into competition with us, and the Southern manufacturers can compete successfully with the Northern manufacturers, what is the prospect for us? The position likely to be assumed by the Southern States is a matter of infinite importance to us."

WILLIAM H. RULOFSON.

Mr. William H. Rulofson, the photographer of San Francisco, Cal., met with sudden death in that city on the 2d of November last, by accidentally falling from the roof of a new building of which he was proprietor. His age was 52 years. His decease has cast a deep gloom over a large circle of devoted admirers and friends. He was a man of rare activity, enthusiasm, and capacity. He was president of the National Photographic Association, and enjoyed the highest esteem of the members. His practical sagacity and strong common sense made him a most useful and prominent man in the community; while his genial, kindly disposition greatly endeared him to all who enjoyed his acquaintance. He leaves a wife and ten children.

An Important Railway Decision.

The United States Supreme Court has decided that the Stevens car brake is not an infringement on the Tanner patent. This reverses the decision of the United States Circuit Court for the Northern District of Illinois, in the case of Sayler *vs.* The Chicago and Northwestern Railway Company. The decision is based entirely on the question of infringement, the validity of the patent not being passed upon.

A SCIENTIFIC INVENTION WANTED.

The microphone has been successfully employed in Italy in studying volcanic and earthquake noises. In some experiments made at Vicenza the telephone emitted sounds which only could be attributed to subterranean agitations. Accordingly Professor de Rossi, of Rome, determined to make some further experiments in an underground observatory of his own at Rocca di Papa, situated on the Alban hills, on the edge of the crater of an extinct volcano. A special microphone, capable of being attached firmly to the rocks so as to feel any motion there might be, was carried down with great care into the observatory, and the reality of the mysterious noises was soon demonstrated. Though uncertain as to their causes, Professor de Rossi was soon able to divide the noises into three classes, which he calls rumblings, musketry reports, and metallic or bell-like sounds. He also discovered that the sounds were periodical at intervals of an hour, or half an hour, or even smaller fractions.

On the night of the 23d of September, at the hour when the explosions of Vesuvius and its eruptive cone were most vigorous, the microphone on the Latin hills was in the greatest agitation. On the following days the same sounds continued, following more or less exactly the course of the eruption of Vesuvius. Wishing to complete his evidence, Professor de Rossi determined to carry his microphone to a place where there was no doubt of being on ground vibrating from inner causes—to the side of Vesuvius and the Solfatara of Pozzuoli. Professor Palmieri not only put at Professor de Rossi's disposal his observatory, but did all in his power to make the experiment a fair one, himself watching at the outer door to prevent all intrusion or accidental noises. They wished here to establish the connection between the motions of the seismograph and the sounds communicated by the microphone. To ascertain this, one of the assistants of the observatory stood over the seismograph to mark the motions with signs previously agreed upon, to record the agitation preceding a shock, the actual shock itself, and whether the motion was undulatory or perpendicular. At the same time the sounds of the microphone were noted, and found to correspond exactly with the motions of the seismograph, and each different motion corresponded to a different sound. In this way it was possible to ascertain the value of the different sounds, which had naturally been impossible at Rocca di Papa; and it appeared that the perpendicular motion corresponded to the musketry reports, and the undulatory to the rumblings; while very often there was an uncertain sound, as had been noticed at Rocca di Papa.

Even more significant results were obtained by observations at the Solfatara of Pozzuoli. It was evident both at Vesuvius and at the Solfatara that the microphone was registering shocks of earthquake otherwise imperceptible; and, as the same sounds had been observed by Professor Mocenigo at Vicenza and Armellini at Rome, there can be no longer any doubt of the existence of microseismic vibrations of the earth as discovered by Bertelli and maintained by Professor de Rossi.

What is now wanted in the application of the microphone to meteorology is to obtain an instrument which will mark automatically all the variety of sounds which the microphone conveys to us; and this will be the much desired "panseismograph," which will show the number, form, and every variety of the vibrations of the earth.

MINING NOTES.

Notwithstanding the incorporation in San Francisco, in the past two weeks, of twenty mining companies with an aggregate capital of over $200,000,000—a significant indication of the spirit still existing there—the legitimate mining interests of California and Nevada continue to improve and invite attention, and quite a number of mines are spoken of as paying well, under proper management, with ores averaging only from $20 to $30 per ton. Among other reports is one that a prospector, while recently exploring on the west side of Bodie Bluff, laid bare with a few strokes of a pick an 8 inch vein of white quartz, almost filled with solid gold, and that the samples assayed over $40,000 per ton in gold and $1,500 in silver. The finding of such hand samples is not unusual, and it has not heretofore been very difficult to "get up" companies on them, but there are many unfortunates who have reason to believe that the "hand samples" contained more gold than all the rest of the mine.

The Standard Mine, of Bodie District, has made a month's shipment of $87,400. New cross cuts and new shafts are being vigorously pushed, and everything is looking well.

In San Bernadino county the finding of a rich ledge of tin ore is reported, many specimens of the ore assaying 40 per cent of tin. Rich and extensive discoveries of chrome are reported from San Luis Obispo. The Extra Company's mine, Copper City, Shasta County, continues very uniformly to ship about $1,000 per diem from a 10 stamp mill, and other mines there are prospering.

On the Comstock lode of Nevada the 2,200 foot drift of the Sierra Nevada has penetrated ore assaying from $80 to $100 per ton, and the vein so far as opened promises, it is said, to be one of the finest ore developments ever made on the Comstock. The lower levels of the Bonanza mines are gradually cooling, and the men are being put to work in them again.

The south lateral branch of the Sutro Tunnel is making excellent advance toward the Julia shaft, but owing to the great heat at the face of the header, 100° Fah., the workmen are on six hour shifts.

The Homestake mine in the Black Hills, with its 80 stamp mill, is crushing about 175 tons per day, of an ore yielding about $9 per ton. The cost of its mining and milling ranges from $2.50 to $3.50 per ton, showing a profit of about $1,000 a day. The October run was $52,000, and expenses $16,000. There could be no better evidence of good mining management than the profitable working of a $9 ore; and those who have grown despondent over their poor mines may now take courage. Indeed, we learn that already many idle mines are resuming work.

How profitable some of these long idle properties have become since reopened is shown in Colorado in the cases of the California and its western extension, the Hidden Treasure. The latter has yielded nearly or quite $180,000 since last February, with a profit of late of from $10,000 to $16,000 per month; and the California is gradually becoming equally profitable, although not sufficiently opened yet to permit of the yield that can be relied on in the coming winter and spring. The Mayflower and Lafayette mines, owned in New York city, are being developed steadily, and show ore in all the shafts as well as in the tunnel. Rich strikes were lately made in both veins, and the production will be large and regular as soon as the requisite developments are effected. The last body of ore opened mills 217 ounces of silver.

On the north shore of Lake Superior free gold tellurides, with copper pyrites, are reported as occurring in large veins, never assaying less than $50 per ton. The Victoria mine, near the Sault Ste. Marie, has developed some fine ore, running 165 ounces of silver and 25 to 65 per cent of lead.

The approach of winter threatens no relaxation of mining enterprise in any direction, and with scarce an exception the prospects are better than ever before.

ALLOYS.

In one of our foreign exchanges we find a description of some very beautiful alloys, applicable as substitutes for gold and silver in the manufacture of jewelry and similar purposes, which have been produced by Messrs. Meiffren & Co., of Marseilles.

To make an alloy having the color and appearance of gold, they place in a crucible copper as pure as possible, platinum, and tungstic acid in the proportions below stated, and when the metals are completely melted they stir and granulate them by running them into water containing 500 grammes of slaked lime and 500 grammes of carbonate of potash for every cubic meter of water. This mixture, dissolved in water, has the property of rendering the alloy still purer.

They then collect the granulated metal, dry it, and after having remelted in a crucible, they add a certain quantity of fine gold in the proportions hereinafter specified. An alloy is thus produced which, when run into ingots, presents the appearance of red gold of the standard $\frac{750}{1000}$, and to which may be applied the name of "aphthite" or unalterable.

They can change the color of the alloy by varying the proportions of the different metals. As flux they use boric acid, nitrate of soda, and chloride of sodium, previously melted together in equal proportions. The proportion of flux to be employed is 25 grammes per kilogramme of the alloy. The proportions they employ, by preference, for producing an alloy of red gold color are: Copper, 800 grammes; platinum, 25; tungstic acid, 10; and gold, 170 grammes.

The alloy used in imitation of silver consists of iron, 65 parts; nickel, 23 parts; tungsten, 4 parts; aluminum, 5 parts; and copper, 5 parts. The iron and tungsten are melted together and then granulated, as in the case of the previous alloy, except that in this instance the water into which the mixture is run contains one kilogramme of slaked lime and one of carbonate of potash per cubic meter.

The nickel, copper, and aluminum are also melted together and granulated by running into water containing the same proportions of lime and potash. Care should be taken during the melting to cover the metals contained in the two crucibles with a flux composed of one part of boric acid to one part of nitrate of potash or niter.

In the crucible containing the aluminum and copper they place a lump of sodium of about two grammes in weight when treating five kilogrammes of the three metals (nickel, copper, and aluminum) together to prevent oxidation of the aluminum, and they also add charcoal to prevent oxidation of the copper.

Before granulating the metal in each crucible, it should be well stirred with a fire-clay stirrer.

The granulated metals are dried, as in the former case, then melted together in the same crucible in the proportions above indicated, and well stirred, after which the alloy is run into ingots.

The alloy thus obtained, to which may be given the name of "siderapthite" (or unchangeable iron), presents the same white appearance as platinum or silver, and is not more expensive than German silver. These improved metallic alloys are capable of resisting the action of sulphureted hydrogen, are unattacked by vegetable acids, and but slightly attacked by mineral acids; they are also perfectly ductile and malleable.

New View of Infection.

The theory that very small organisms, either vegetable or animal, are the cause of all infectious diseases, is very generally accepted at the present day. It passes as established and almost mathematically proven, because this theory alone is able to explain for us a series of phenomena that would otherwise be totally inexlipcable. Hence the *alpha* and *omega* of all precautions directed against infectious diseases and epidemics consist in combating and destroying these organisms.

THE BREEDING OF EELS.

The mystery which has hitherto attended the propagation of eels has at last been cleared up by the discovery of ripe ovaries by Professor Baird, and more recently Professor Packard's discovery of a male eel. Professor Baird's observation was made last year, but it was not confirmed until Mr. Eugene G. Blackford pointed out the ovaries to fishermen, fish dealers, and others, about Fulton Market a little while ago. Curiously the charged ovaries have been in plain sight from the first, the minuteness of the eggs causing their character to be unsuspected. "Oh, yes; that is what we call eel fat; it is always plenty at this time of the year," said the fishermen, when their attention was called to the egg mass. After showing the ovaries to his eel dressers, Mr. Blackford directed them to watch for any departure from the usual appearance—thus far without success. The question of the eel's sexuality has been set at rest, however, by Professor Packard's discovery. The male eel appears to be very rare. The ovaries of an eel weighing six pounds were examined recently by Mr. Frederick Mather, who found the eggs to average $\frac{1}{16}$ of an inch in diameter. Mr. Mather then proceeded to estimate the number of eggs contained in the eel, which was done by carefully subdividing the mass until a quantity which could be counted was obtained, and then the number of eggs was multiplied by the number of divisions. The mass was halved, quartered, etc., 17 times, making the last section 1-131,072 of the whole. To avoid error, this was done three times, giving the first time 68 eggs, or 8,912,896 in the whole. The second trial gave 77 eggs, or a total of 10,092,544, while the third yielded 71 eggs, which showed the mass to contain 9,306,112.

Considering the minuteness of the eggs, these different results are remarkably near each other, and Mr. Mather fixes the numbers contained in this individual fish at 9,000,000, which, when we consider that each of the ovaries was nearly a foot in length, and about a half inch in diameter at the thickest part, does not seem to be at all exaggerated.

SANITARY USES OF GUNPOWDER.

A correspondent writes us from the Sandwich Islands saying that during a long life spent in tropical fever districts he has been able to escape infection and miasma by the use of gunpowder, supplemented by a few simple precautions against sudden changes of temperature, sunstroke, bad water, and the like. He uses no water that has not been boiled and afterwards kept from air contact; but his main reliance is upon the practice of burning a thimbleful of gunpowder in his bedroom and very small quantities in his trunk, wardrobe, etc., so as to keep his clothes in an atmosphere feebly charged with gunpowder gas. In Madagascar, Reunion, Mauritius, the East Coast of Tropic Africa, and other fever-smitten lands he has found such simple means a sure preventive of epidemic and endemic diseases, and has thereby been often brought to the phi'osophic reflection that gunpowder is destined to invert the aim intended by its fabrication.

HAIR ON THE MUSK TURTLE.

Mr. Carl F. Gunther says that he has observed on the common musk turtle (*Test. moschata*) a growth of hair similar to that of the hairy turtle figured in a recent number of the SCIENTIFIC AMERICAN. On a young one, which he caught last fall, in a swamp in Westchester County, N. Y., the fine hairs could be readily distinguished by the aid of a magnifying glass. It sometimes happens that a semblance of hairiness is produced by vegetable growths on the shells of these sluggish creatures living in swamps. Possibly our correspondent may have been misled by such an appearance.

THE CONSTITUTION OF MATTER IN THE GASEOUS STATE.

The development of the kinetic theory of gases covers an enormous advance toward the solution of the great problem of the constitution of matter—a subject, withal, of extreme importance just at this time in view of Mr. Lockyer's reported resolution of the problem. Whether all matter is proved to be fundamentally one, as Mr. Lockyer asserts, or of several irreducible elements, as chemists have believed hitherto, the discoveries made during recent years with regard to the constitution of gases will mark an era not only in the history of chemistry, but in the wider history of human effort to penetrate the secrets of nature.

A masterly review of what has been done of late years in this direction will be found in the SCIENTIFIC AMERICAN SUPPLEMENT (No. 156), from the hand of Professor Charles Adolphe Wurtz, of the Ecole de Médecine, at Paris. Nowhere will the student find a more compact, lucid, and thorough explanation of the physics and chemistry of matter in the gaseous state. We may add that in furnishing, for the small sum of ten cents, articles of such sterling and especial value, the SUPPLEMENT is doing for American readers what has never before been attempted in any country.

Manufacturing Industries.

Believing that the readers of the SCIENTIFIC AMERICAN will be interested in a series of articles on some of our largest manufacturing industries, we have in preparation engravings for illustrating and describing several of the most important establishments in the country. The first of the series will be a representation and description of the interior of Lorillard's Tobacco Factory, Jersey City, and will appear in the next issue.

THE RAPIEFF ELECTRIC LIGHT.

This light has passed the experimental stage, and is actually employed in the printing office and composing rooms of the London *Times* newspaper.

The chief novelty of the system consists in the use of four carbons, instead of the two which, in nearly every other arrangement, form the points between which the luminous arc is produced. These carbon rods, instead of being placed parallel with one another, are so inclined that their points meet. Or to put the matter more clearly, the two upper carbons form the letter V, while the two others, forming the same letter upside down Λ, are placed so that the combination represents an X. But the lower pair are set at a right angle to the upper. In plan, therefore, the four rods would form a cross.

One great advantage in M. Rapieff's system is that a nearly burnt-out carbon may be replaced by a fresh one without any stoppage of the light. This operation, too, can be performed without the intervention of a skilled worker. In Fig. 1 the attendant—protected from the glare of the naked light by a small screen of colored glass—is in the act of replacing one of the negative carbons. The right hand lamp is shown as commonly used, with the light softened by a globe. The screw, S, in both lamps, is the means whereby the distance between the two pairs of carbons is regulated and kept constant. Indeed, we understand that the size of the arc can be so adapted to the current supplied, that a lamp can be made to represent the value of 100 gas flames, or of merely 10.

This system can be used with a magneto-electric machine of any pattern. The lights have each an independent existence, that is to say, one or two can be extinguished without affecting others in the same circuit. And the system offers the advantage of satisfactory subdivision without very great loss in the individual intensity of each light.

The carbons, as they consume away, are made slowly to approach each other, so that the arc is always of the same width, and keeps its fixed position in the space. To this effect the carbons are directed together over small pulleys at *d* (Fig. 2). The directing force is supplied by a lead weight or counterpoise, *w*, of about three pounds, which slides down the brass stems, *s s'*.

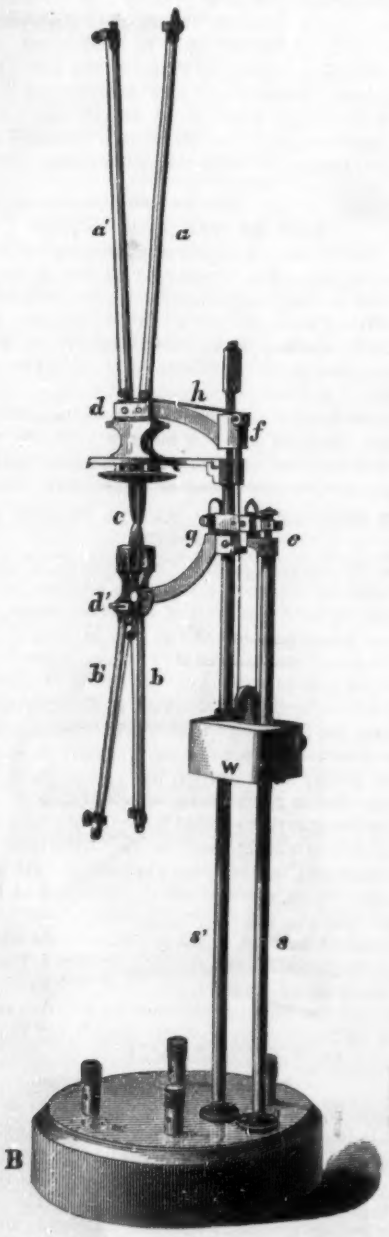


Fig. 2.—THE RAPIEFF ELECTRIC LAMP.

The weight is supported by two silk or asbestos cords from the outer ends of the carbon sticks. In this way the descent of the weight draws the four carbons equally together as they are wasted away. A curved reflector of silvered brass or porcelain is fixed a little above the inner ends of the upper carbons. By means of the screws, *f* and *e*, the width of the arc is adjusted, and by similar screws the angle at which the lower points face the upper ones can be varied, so as to direct the arc to one side or the other. The wooden base, B, carries four terminals for connecting the wire conveying the current. The base is hollow, and contains an electro-magnetic apparatus for starting the light. At first the carbon points are in contact, but when the current is put on, it passes through a dual electro-magnet in the base, the armature of which is attracted upward and pushes a rod up the hollow stem, *s'*. This rod allows the lower carbon to drop away from the upper to the full width of the arc as previously adjusted. The positive and negative currents pass to their respective upper and lower carbons by means of the stem, *s s'*, and the curved brackets. With carbons 20 inches long and 5 millimeters in diameter, the light is maintained for seven or eight hours, and with those 6 millimeters thick it is kept up for nine or ten hours. The light is equivalent to from 100 to 120 gas flames, or say about 1,000 candles. The smallest form of the lamp made gives a light estimated at five gas flames. M. Rapieff is now constructing a form of lamp made to burn upside down, in order that it may be fixed on the ceiling of rooms. Mica plates are sometimes used to screen off the heat from the cords when they are of silk. The resistance of the arc is only two or three ohms.

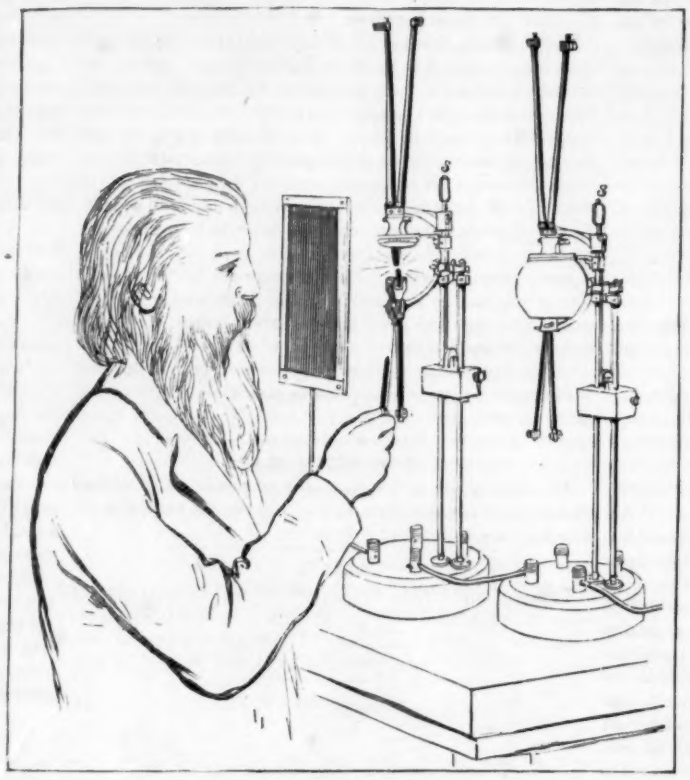


Fig. 1.—THE RAPIEFF ELECTRIC LIGHT.

Fig. 3 represents a modified form of Rapieff's lamp. In it the carbons are simply inclined to each other at an angle which can be regulated by screws, *d d'*. The width of the arc can also be regulated by the same screws. The carbons are drawn together by the descent of a counterpoise, *w*, in a similar manner to that above described. In the lamp the planes of the carbon pairs are parallel to each other. A cylinder of lime, *e*, is supported over the arc, and becoming luminous increases the illuminating power of the arc by about 40 per cent. The carbons M. Rapieff employs are made by M. Carré. The light is very pure and white, and can be considerably varied in intensity by the adjusting screws. Gramme's dynamo-machines are at present used in the *Times* office, but we believe that M. Rapieff has patented one of his own. There are six lamps in each circuit in the *Times* office, but M. Rapieff has successfully exhibited as many as ten.

Action of Water and Salt Solutions on Zinc.

The results of a series of experiments made upon this subject by Snyders may be given briefly as follows:

1. Zinc decomposes salt solutions, concentrated as well as dilute, without access of air or oxygen. Hydrogen is liberated, and oxide of zinc is formed.

2. The solubility of oxide of zinc in the salt solutions hastens and aids the reaction.

3. Oxide of zinc dissolves in solutions containing but 1 per cent of salt, or even if more dilute. The solubility in different salts is different, being greatest in ammonia salts. It seems to be due to the formation of free alkali, inasmuch as it can exist in solution with a double zinc salt at certain temperatures and by certain concentration. Zinc carbonate and hydrate are not soluble in the carbonates. The solubility of zinc oxide increases as the temperature and concentration increase.

4. If the salt solution is saturated with oxide of zinc the decomposition does not go any further, but the zinc oxide formed subsequently remains undissolved. But few experiments have been made in this direction, and others will be instituted by the same person.

5. With access of oxygen free from carbonic acid the oxide dissolves more rapidly because the zinc oxidizes at the same time. The salt aids this oxidation, not directly, but by keeping the surface clean. This, too, requires to be substantiated by further experiments.

6. The solvent action is somewhat retarded by the carbonic acid of the air, owing to the formation of some basic carbonate upon the surface of the zinc.

7. The decomposing and solvent action is greatest in the case of the chlorides and with potassium sulphate, weaker with the nitrates of the alkalies and of barium, and for magnesium sulphate.

8. Zinc does not decompose solutions of alkaline carbonates or sodium phosphate in the absence of air. With access of air but little zinc is dissolved by one per cent solutions, because the zinc is protected by the zinc carbonate or phosphate formed by the reaction. In diluter solutions somewhat more zinc oxide is dissolved.

9. The action increases with increase of temperature; at the freezing point of water it is very slight.

10. Solutions of ammoniacal salts take up more zinc than the solutions of the salts of the fixed alkalies. The zinc remains bright in these solutions, and nothing separates, even if oxygen or air is permitted to enter.

11. Hard well water does not act upon zinc, even with large percentages of chlorides and sulphates. Soft water dissolves more zinc in proportion as the amount of chlorides, sulphates, and nitrates exceeds that of the carbonates and phosphates.

The poisonous nature of zinc salts, even in small doses, renders the above research of more than ordinary practical interest.

THERE is no simpler or better remedy for frost bites than the following: Extract the frost by the application of ice water till the frozen part is pliable, avoiding all artificial heat; then apply a salve made of equal parts of hog's lard and gunpowder, rubbed together until it forms a paste, and very soon the frozen parts will be well.

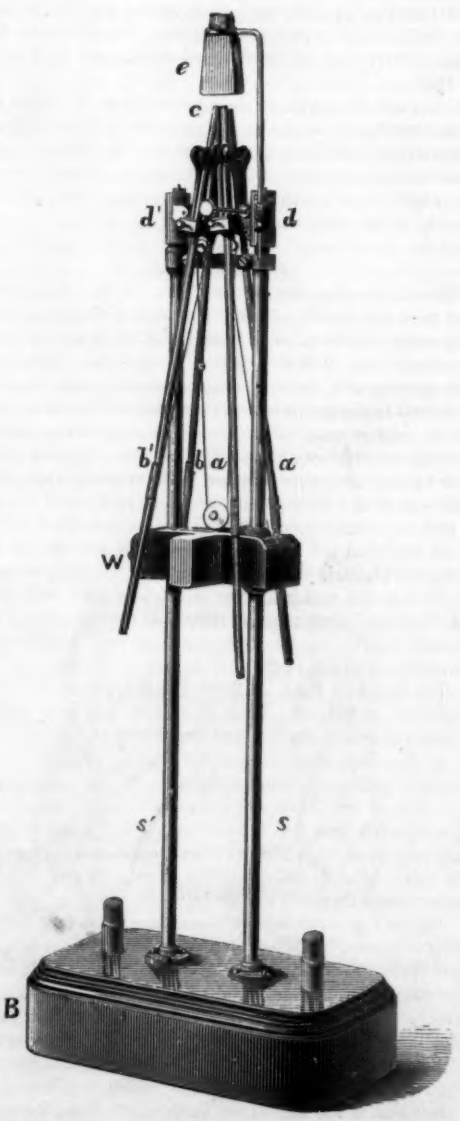


Fig. 3.—MODIFIED FORM OF RAPIEFF LAMP.

A NEW FOOT LATHE.

It is an important matter for an amateur or mechanic doing work with small tools to procure such implements as will be a source of profit, pleasure and satisfaction, instead of lasting regret that tools of another make were not purchased. Among such tools a lathe is an important item, and once purchased is not likely to be soon exchanged. A lathe which appears to fulfill all reasonable requirements is shown in the accompanying engravings. The chief novelty of this

Fig. 1.—MARSH'S CYLINDER BED FOOT LATHE.

lathe is its cylindrical bed, which possesses many advantages which will be apparent to our readers. The bed is 36 inches long, and the head, tail, and tool stocks are bored to fit it.

The head stock is fastened permanently with a set screw. The tail stock traverses the whole length of the bed, and is kept in line with front center by a groove in the bed, and is readily fastened at any point by turning a hand screw, which is on the back side of lathe and not shown in cut. The tool stock also encircles the bed, moves back and forth readily, and rocks to and from the work. It is sawed open on the bottom, and provided with a screw, which is sufficient to hold it at any point by a single turn of the hand. It has a steel mandrel, two steel centers, two T rests, and a tool shelf.

It has a brass box in front journal, and true bored iron bearings throughout. It has a three cone grooved pulley, turned up true, and polished. The balance wheel is turned and grooved to correspond with cone pulley, and is weighted to counterbalance the treadle. The crank shaft runs the whole length of lathe, resting in Babbitted journals, and has a crank on each end, thus avoiding any unequal strain upon the frame, and securing steadiness. It runs lightly and freely, with high speed.

This lathe has three useful attachments: a circular saw attachment, a bracket moulding device, and a scroll saw. The circular saw attachment, shown in Fig. 2, is easily applied, and the table, which is a light iron one, dressed up true, is supported by a standard set in the tool stock, and admits of being rocked and tipped so as to saw any bevel desired. It has two light running metal gauges for slitting and cutting off.

The scroll saw attachment (Fig. 3) is very simple, and useful for sawing all kinds of scroll and fret work. It is readily attached or detached without pulling the lathe in pieces. The driving attachment of the saw has a perpendicular stroke, which is important in the perfect working scroll saw. The spring and tension are firmly attached to the tail stock without the removal of a bolt or screw. The table tilts 45° without losing its central position, and the swing around under the arm is 25 inches.

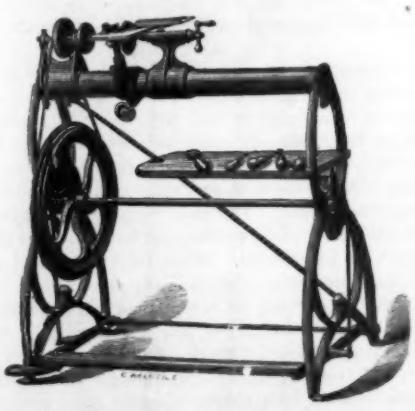


Fig. 2.—LATHE WITH CIRCULAR SAW ATTACHMENT.

The attachment shown in Fig. 4, for moulding and ornamental brackets and other scroll work, adds, with very little expense, a very desirable feature to the foot lathe. The standard of the table is threaded, and is adjusted up and down by turning it around. The capacity of the cutter is such as to follow the scroll saw into very delicate points, and open and mould them so as to give the work a more open and light as well as a more ornamental appearance. The cutters have double cutting edges, and cut as well when revolving one way as the other.

This lathe is manufactured under the recent patent of E. A. Marsh, by the Battle Creek Machinery Company, Battle Creek, Mich., from whom further information may be obtained.

Recent Engineering Inventions.

Mr. Erastus B. Kunkle, of Fort Wayne, Ind., has patented an improved Gauge Cock for Steam Boilers, which consists of a tube having its upper end closed by a nut, through which the valve stem passes, and provided with a vacuum chamber between the nut and the discharge pipe, for preventing the steam or water from passing through the threads of the nut and scalding the operator. It has a valve seat at its inner lower end, as near as possible to the boiler, leaving no space for sediment or scale to collect and clog the valve.

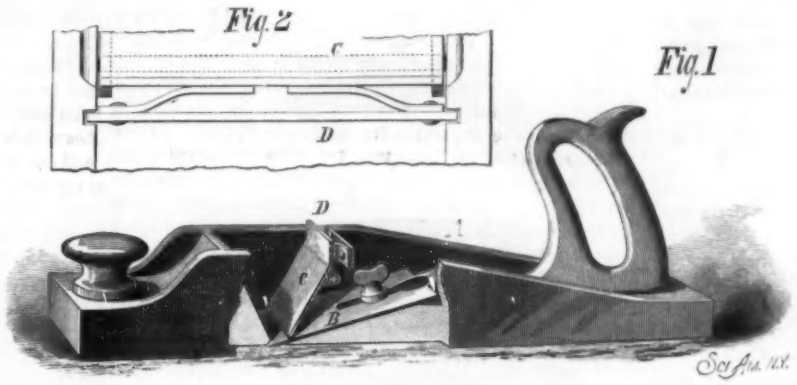
An improvement in Drilling Machines for Artesian and other Wells has been patented by Mr. Jesse Button, of New York city. The object of this invention is to construct the framework and machinery used in boring artesian and other wells in a compact and convenient form, for saving labor and space, and to enable the machine to be conveniently moved from place to place.

A NEW BENCH PLANE.

The accompanying engraving represents an improved bench plane, recently patented by Mr. Patrick Gallagher, of Eureka, Nevada. In Fig. 1 the side of the plane is broken away to show the internal construction, and Fig. 2 is a detail view of the cap supporting device.

The improvement is applicable to either a jack plane, fore plane, or jointer, of wood or iron.

The iron or bit, B, is screwed by a clamp screw in the body of the plane, A, forming a small angle with the bottom of the plane, and it is held in position near its cutting edge by the cap, C, which is pivoted on a pin that runs transversely through the plane. The position of the cap above its pivot is pressed forward by two strong springs that are supported by a cross bar, D, fitted to slots in the sides of the plane. These springs keep the cover down on the lower end of the bit or iron, holding it firmly in place. As the cutting iron lies more nearly flat than in ordinary planes it will make a smoother surface, and it is more easily adjusted than irons fastened with a wedge in the usual way.



GALLAGHER'S PLANE.

New Inventions.

Mr. Jonathan Miller, of Trenton, N. J., has patented an improved combined Urn and Water Bottom. This is a stoneware receptacle for beverages, provided with a water bottom having communication with two tubes formed upon the outside of said urn, into one homogeneous piece therewith.

Mr. Eliot S. Hunt, of Elizabeth, N. J., has patented an improved Gate Hinge, constructed so that the gate when closed may be in line with the fence, and will allow the gate to be swung back against the fence without straining the hinges.

Mr. Francis Keil, of New York city, has devised an improvement in that class of Cylinder Latch Locks which cannot be opened from the outside of the door without its own especial key. It is simple in construction and not liable to get out of order.

Mr. John S. Birch, of Orange, N. J., has patented an improved Gun Wiper, having a novel device for connecting the wiping head to the rod, whereby the variations in the sizes of the screw shanks of different heads will not interfere with connecting different heads with the same rod.

An improved Device for Forcing Air into and through the Water contained in Wells, cisterns, tanks, and other vessels to purify it, has been patented by Messrs. Jerome S. Higgins and Riverious T. Higgins, of California, Mo.

Mr. John H. White, of Huntsville, Ala., has patented an improved Match Splint, which is triangular in form. The advantages claimed are a saving in material, producing with a minimum expenditure of material a strong splint. The sharp angles of the splint afford a ready and effective medium for rapidly communicating the flame from the head to the body of the splint, and, as a larger number of splints can be cut from a given quantity of wood, it follows that for purposes of transportation a given number of splints can be packed in a smaller space.

An improvement in Adjustable Sieves has been patented by Mr. John Dildine, of Milton, Pa. The object of this invention is to furnish an improved sieve for sifting flour,

Fig. 3.—SCROLL SAW ATTACHMENT.

meal, seeds, and other things requiring to be sifted or separated. It is so constructed that it may be readily adjusted to make the meshes smaller or larger, as may be required.

Mr. Henry Hardick, of Liberty, N. Y., has patented an improved Fence. This invention consists in a metallic post having an anchoring cross bar or foot cast upon its lower end, and buttons upon one of its vertical sides, for the attachment of the wire rails; an intermediate stay post is also provided, which anchors a vertical cross tie connecting the longitudinal wire rails.

Mr. Louis R. Sassinot, of New Orleans, La., has invented an improved Portable Furnace. This invention is designed for portable clay furnaces to provide a basket frame that will at the same time serve as a permanent support.

Mr. Simon H. Wiesedeppe, of Seneca, Kan., has patented an improved Animal Trap, which is simple in construction, inexpensive, and reliable, catching the animal and holding him securely without hurting him, and without alarming other animals that may be near.

Mr. Heinrich Baum, of Höchst-on-the-Main, Germany, has patented an improvement in Coloring Matters to be used as Dyes. This invention consists in manufacturing red, yellow, and brown colors from the two disulphobetanaphtholic acids by means of diazo compounds of xyloidine.

Mr. Benjamin Landon, of Canton, Pa., has devised an improved Mouth Piece for Mail Bags, that can be easily and quickly opened and closed, and that will remain open when matter is being taken from the bag without being held, but at the same time can be securely closed and locked.

A Hose Cart, which may be used to transport hose from place to place, and in which the motion of the cart is made available for winding or unwinding the hose rapidly without straining it, has been patented by Mr. John Wilz, of Santa Cruz, Cal.

Mr. Andrew Sheridan Burt, of Omaha, Neb., has patented an improved Tent, having a double row of eyelets or grommets along the edges of the sections of canvas which form

Fig. 4.—BRACKET MOULDING ATTACHMENT.

the ridge, and having flexible knotted chain loops adapted to be laced diagonally.

Mr. Paren England, of Lincoln, Neb., has devised a combined Sash Lock and Weather Strip, designed to both lock the sash in any position, and at the same time totightly close the joint between the sash and the framing, to prevent the entrance of cold air, dust, or snow.

Theory and Practice.

At a recent meeting of the California Academy of Sciences, Professor Joseph Le Conte remarked as follows:

There is a common, deeply rooted prejudice in the popular mind—and it seems to be affecting even scientific men, on the one side, as well as practical men on the other—that there is a kind of antagonism between theory and practice.

Now, so far from this being the case, a true theory is indissolubly connected with a true practice. There is an indissoluble marriage bond between them. It is even closer than this: it has the relation of spirit and body. Science is a complex web, woven warp and woof; the warp is scientific theory, the woof is the material derived from nature. It is impossible that one should exist apart from the other. Every intelligent human action, particularly of the complex kind, is necessarily guided by theory. And this is the true difference, in fact, between human activity and ordinary animal action. Human action is the most complex, and it is always guided by theory. The only difference between good practice and bad practice is that one is guided by good theory, and the other is guided by false or bad theory. But all human action which pretends to be intelligent or rational, is guided by some theory, good or bad.

There is, I admit, a kind of theorizing, a spirit of theorizing, and a theorctical habit of mind, which is destructive of good practical work. But it is equally destructive of true science also. I refer to that theorizing upon an unsubstantial basis, that theorizing merely for the sake of theorizing, and merely for the pleasure of the intellectual activity of theorizing—merely for the self-complacent contemplation of the beauty of the theories that we create out of our minds. In this case the whole web, woof and warp, is woven out of the human mind, without the material being furnished to it by nature. It is like castle building in the air, unsubstantial and resting upon a cloud; beautiful it may be to contemplate, but rapidly disappearing before the sun. It is like spiders' webs, woven out of its own bowels, both warp and woof; beautiful and intricate in its structure, and glittering with the dew in the early morning, but quickly brushed away from the path of progress. This kind of theorizing is equally as fatal to true science as it is to practical work.

This kind of theorizing is what we would call speculation. Now speculation bears the same relation to true theorizing in the world of science, which speculation bears to legitimate enterprise in business. As speculation in the field of business is prostrating to true enterprise, and through it prostrating to the true prosperity of the community, even so speculation in the realm of science is destructive to true theorizing, and therefore destructive to real practical work.

But as enterprise is the basis upon which all legitimate industry rests, and must inevitably rest, and the whole prosperity of society must also rest with it, even so it is upon sound, cautious, inductive theorizing that the whole progress of science and also of sound practical work is based. Science is the open foe of speculation in both fields. Science is the fast friend of legitimate enterprise and legitimate industry, also, in both fields.

The Evaporation of Moisture from Leaves.

An exhaustive study on the physical functions of leaves has recently been published by Professor J. Boussingault, of Paris, in which the phenomena connected with the absorption and transpiration of leaves are treated at great length.

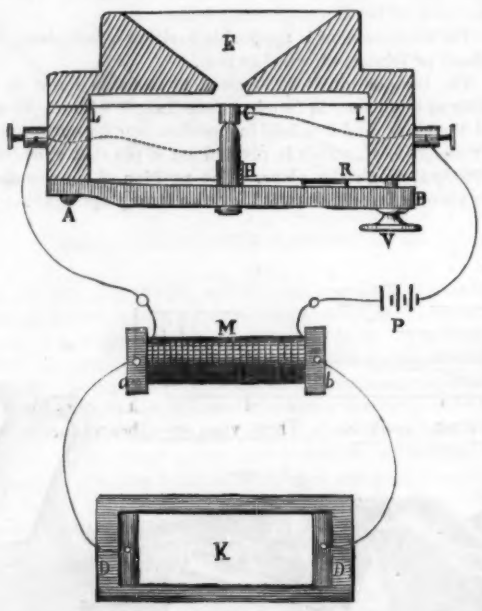
Among others, numerous experiments were made on the difference in evaporation during the day and night. Those carried out with the leaves of the grape vine gave the following hourly averages per square meter of foliage: in sunshine, 35 grammes (560 grains); in shade, 11 grammes (176 grains; during the night, 0·5 gramme (8 grains). The trellis on which the vine was trained was 30 inches high and 125 feet long, and presented a surface of 406 square feet of foliage. In sunny weather this was found to lose by evaporation in the course of 24 hours, 120 lbs. of water, and nearly half of that amount during cloudy weather. To give an idea of the enormous amount of aqueous vapor dissipated by plants in the sunshine, calculation showed that an acre of beets could lose in the course of 24 hours between 20,000 and 23,000 lbs. Another experiment made with a chestnut tree 35 years old showed that it lost over 16 gallons of water in the course of 24 hours. The structure of the leaf, however, containing 70 to 80 per cent of water, and possessing a thickness frequently of not more than four-thousandths of an inch, the question might occur why the evaporation is not much more rapid. The answer to this is found in the peculiar structure of the tissue forming the epidermis, designed especially to moderate the transpiration. In order to observe the remarkable retentive power exercised by this epidermis, one may expose for a few hours to the sun two cactus leaves of the same superficies, one of which has been deprived of its epidermis. In the case of the latter the evaporation will be about fifteen times as rapid as in the other. It is the presence of a similar tissue, forming the skins of fruits, which prevents an evaporation that would be otherwise too rapid. An apple, for instance, deprived of its skin, loses 55 times as much water as a whole specimen in the same time. The physiological energy of leaves is notably lessened by losses resulting from rapid evaporation. Thus an oleander leaf, containing 60 per cent of water, when introduced into an atmosphere containing carbonic acid, decomposed 16 cubic centimeters of this gas; one containing 36 per cent decomposed 11 cubic centimeters, and one containing but 29 per cent was without action.

IMPROVED MUSICAL CONDENSER.

Some time ago Mr. Varley constructed an apparatus, called by him the "musical or singing condenser," and the same is now being exhibited in London and attracting general attention. The apparatus, like so many others of similar character, is too complicated and incomplete for practical purposes. It consists of the receiver, the transmitting apparatus, and the condenser. The latter, K, is composed of a pile of leaves of paper and tinfoil, following alternately; the pairs 2, 4, 6, etc., are united together at one end; the pairs 1, 3, 5, etc., at the opposite end. The whole is inclosed by copper frames, D D', supplied with screws to connect the wires. The sheets may be firmly compressed, the operation not being disturbed thereby in the least.

The receiving and transmitting apparatus consists of a sort of telephone, E. The place of the diaphragm is filled by a sheet of metal foil, L L, in the center of which is fastened a cylindrical piece of carbon, G. Against the latter is placed a second carbon cylinder, H, resting on a wooden crosspiece, A B, fastened at A to one wall of the case, B, by means of a regulating screw, V, to the other wall. A spring, R, extending across the board, A B, imparts to the latter a certain degree of elasticity, which is necessary to insure success.

The metal sheet receiving the sound is connected with one of the poles of a battery, consisting of six Leclanché cells; the lower carbon cylinder is connected with the primary helix of the induction coil, M, which connects on its part with the other pole of the battery. Finally the two poles of the secondary helix of the coil are connected with the ends, D D', of the condenser.



VARLEY'S MUSICAL CONDENSER.

The secondary helix of the coil consists of twenty layers of No. 32 wire, well covered with silk; the primary helix consists of five layers of No. 16 wire. The length of the coil does not exceed 2¾ inches, and the core is ⅜ inch thick.

The receiving and transmitting apparatus must be regulated by experimenting. The two carbon points, when at rest, should not touch each other, but must be brought into contact by the slightest vibration of the metal sheet. The right position may be determined as follows: When the same note is repeatedly sounded into the collector, the carbons may be approached till the sound is distinctly reproduced. When three notes, sounded in succession into the collector, are plainly heard from the condenser, the apparatus may be considered sufficiently well regulated. The melody must be sung into the receiver while the mouth is placed as near as possible to the entrance. Voices resembling the sound of a flute are most easily reproduced.

The apparatus may be used in the same way as Edison's telephone. When it is used as a microphonic receiver, the carbon points must be brought into contact.—*L'Electricité.*

Natural History Notes.

An Aquatic Fern.—Professor D. C. Eaton, in a communication to the *Bulletin of the Torrey Botanical Club*, announces four additions to the fern flora of North America. These are all tropical species, and were detected in Florida. One of them, *Ceratopteris thalictroides*, is one of the most peculiar of ferns, and was discovered growing in the waters of Prairie Creek. It is as truly an aquatic plant as pickerel weed (*Pontederia*), or burr-reed (*Sparganium*), and has been found in still or slowly moving waters in most tropical and many sub-tropical regions. It occurs in several of the West Indies, in Mexico, New Granada, and Brazil, and in Africa, Madagascar, India, Java, Hong Kong, Australia, etc. The sterile frond varies from a perfectly simple leaf to one which is twice or three times pinnate; the simpler ones are floating, and are produced early in the season, and the more compound fronds come later, and are emergent. The veins are everywhere finely reticulated. The fertile fronds have very numerous linear, or somewhat podlike segments, with the margin reflexed to form a broad and continuous membranaceous involucre. The sporangia are scattered on the backs of the veins, and are nearly globose in form, and are more variable in respect to the ring than in any other fern. This organ is sometimes entirely wanting; at other times it is composed of a few obscure joints; and again it is broad and nearly complete. So variable is this fern that at least four genera and two suborders have been found for its reception; and, though Hooker placed it at the end of the *Pterideæ*, its proper position among ferns is by no means yet settled. Up to the present but two sterile specimens of this curious plant have been found, but it is hoped that ere long the discoverer, Dr. Gurber, may be successful in his search for fruiting fronds.

Embryology of the Gar Pike.—The gar pike (*Lepidosteus*) being one of the few living survivors of those vast extinct orders of geologic ages, it has been considered especially important by naturalists that means should be taken to compare its embryology with that of other modern fishes in order that the structure of past races might be more fully known, and more light thrown on modern questions of evolution. As much as this knowledge has been needed, no one had been successful in raising the young of the gar pike till last summer, when Mr. Alexander Agassiz accomplished it. The results of his observations are recorded in a paper read before the National Academy, in this city, during November. The gar pike ascends the St. Lawrence in May, and about the 20th lays its large viscous eggs, which stick fast in an isolated way to whatever they happen to alight on. The eggs look very much like those of toads, having a large outer membrane and a small yolk. Mr. Agassiz's assistant brought to Cambridge about 500 naturally laid eggs, all but thirty of which were destroyed by mould. The young began to hatch in six days, and Mr. Agassiz began his studies, the misfortune to the eggs preventing any examination previous to the birth of the fish. He found that the little gar pikes were not so different from the young of the bony fishes as he expected. He did not make out the development of the lung; but, judging from external characters, the difference is small. Connection with the sharks was exhibited in the similarity of the branchial arches, and by the presence of the lateral fold in which the pectoral fins are formed. The manner in which the tail is developed was found to be very like what takes place in the bony fishes. Among the ganoids the dorsal cord is at first straight, then it assumes a slight curve upward at the extremity, and finally there appears, underneath, the beginning of a lobe pointing toward the complete heterocercal tail. This is likewise so in the bony fishes; but in the gar pike it is a permanent condition, while in the bony fishes the extremity of the dorsal cord becomes extinct. The mode of development of the pectoral lobe furnishes another point of resemblance. A likeness to the shark is noticeable in the brain and mode of formation of the gills. The young gar pikes are slow in their movements, swimming about but little, and attaching themselves to fixed objects by an extraordinary horseshoe-shaped ring of sucker appendages about the mouth. The summing up of Mr. Agassiz's investigations is, that the young gar pike has many characteristics in common with the sharks and skates, but is not so different from the bony fishes as has hitherto been supposed.

The Sequoias.—Mr. John Muir has an interesting paper in *Harper's* upon the "New Sequoia Forests of California." He gives therein the details of a discovery by himself of a grand forest of *Sequoias* seventy miles long, lying considerably south of the isolated groups hitherto known, and containing large numbers of saplings, which indicate that the species is still in a vigorous state of existence. It has heretofore been argued that the few groups of these trees known made it probable that the species was dying out from its last strongholds upon the earth, for it has come down to us from pre-glacial times, when it existed in Europe also, as geology testifies. Mr. Muir's researches lead him to believe that the species has never been more extensively distributed on the Sierra in post-glacial times than it is now; and that to-day it is as full of life and vigor as it was 10,000 years ago.

Instinct in a Crab.—Dr. Darwin, in his "Voyage of a Naturalist," thus describes a crab which makes its diet of cocoanuts, and which he found on Kneeling Island, in the South seas:

"It is common on all parts of this dry land, and grows to a monstrous size. It has a front pair of legs, terminated by a strong and heavy pincers, and the last pair by others which are narrow and weak. It would at first be thought quite impossible for a crab to open a strong cocoanut covered with the husk; but Mr. Liesk assures me he has repeatedly seen the operation effected. The crab begins by tearing the husk, fiber by fiber, and always from that end under which the three eyeholes are situated. When this is completed the crab commences hammering with its heavy claws on one of these eyeholes till an opening is made; then turning around its body, by the aid of its narrow pair of pincers it extracts the albuminous substance. I think this is as curious a case of instinct as I ever heard of, and likewise of adaptation in structure between two objects apparently so remote from each other in the scheme of nature as a crab and a cocoanut."

A Viviparous Cockroach.—At a recent meeting of the Entomological Society of London, Mr. Wood-Mason stated that it might interest the members of the Society to hear that in the course of his anatomical work he had discovered a remarkable case of viviparity in the orthoptera, in a large cockroach belonging to the genus *Panesthia*, the species of which inhabit the tropical forests of Southern Asia and of Australia, where they live in the rotten wood of fallen

trees The species in question was *Panesthia Javanica*, from the abdominal brood pouch of the female of which he had extracted young white specimens of 6·5 mm. in length; and these, from their being already provided with legs, antennæ, black eyes, and the full number of already hard tipped gnathites, as well as from their size, he judged were just on the point of birth when the mother was thrown into the alcohol. He further suggested that the curious and as yet unexplained habit evinced by several European species of cockroaches (*Blattidæ*) of carrying their egg capsules about with them for a week, or even for so long a period as a fortnight, before depositing them, might possibly be explicable as the retention of a vestige of a lost viviparous character.

Astronomical Notes.

OBSERVATORY OF VASSAR COLLEGE.

The computations in the following notes are by students of Vassar College. Although only approximate, they will enable the ordinary observer to find the planets.

M. M.

Positions of Planets for January, 1879.

Mercury.

On January 1 Mercury rises at 6h. 20m. A.M., and sets at 3h. 47m. P.M. On January 31, Mercury rises at 6h. 16m. A.M., and sets at 3h. 23m. P.M.

Mercury can be seen only in the morning. On the 16th it will be in its best position, and will rise about 6 A.M. It can probably be seen in the southeast.

Venus.

Venus will not be seen in the early part of the month. On January 1 Venus rises at 8h. 2m. A.M., and sets at 5h. 2m. P.M.

On January 31 Venus rises at 8h. 3m. A.M., and sets at 6h. 16m. P.M. Venus and Jupiter will be nearly in the same position on the evening of the 23d.

Mars.

On January 1 Mars rises at 4h. 52m. A.M., and sets at 2h. 11m. P.M.

On January 31 Mars rises at 4h. 36m. A.M., and sets at 1h. 32m. P.M.

It will be seen that Mars can be visible to the eye in the early morning only; like Mercury, it rises south of east.

Jupiter.

Jupiter sets early all through the month. It rises on January 1 at 9h. 17m. A.M., and sets at 7h. 1m. P.M.

On January 31 Jupiter rises at 7h. 39m. A.M., and sets at 5h. 39m. P.M. Jupiter and Venus have nearly the same position on January 23.

Saturn.

Our distance from Saturn is increasing, and the planet is less conspicuous, but is readily found as soon as the daylight is out. It passes the meridian on January 1 a few minutes after 5 P.M., and on the 31st at 19m. after 3 P.M., at an altitude of 45° to 46°. Saturn sets on the 1st at 10h. 57m. P.M., and on the 31st at 11m. after 9 P.M.

The satellite Titan can be seen with a small glass. On December 14 this satellite was seen far on the left of the planet (with an inverting telescope), and as it repeats its journey in sixteen days, it will be found in that position again on the 30th, and again on January 15.

The smaller satellites of Saturn can be seen only by the aid of large telescopes. At times six of the moons are seen surrounding the planet, sometimes lying along its path and sometimes grouped together around the tips of its ring.

Uranus.

The distant planet Uranus rises on January 1 at 8h. 59m. P.M., and sets at 10h. 17m. of the next morning. On January 31 Uranus rises at 6h. 56m. P.M., and sets at 8h. 17m. A.M. of the next day. This planet, which was at one time near Regulus, is now near the star Rho Leonis.

Neptune.

On January 1 Neptune rises at 52m. after noon, comes to meridian at 7h. 40m., and sets at 2h. 20m. the next morning. With small telescopes it can be seen as a star. As it comes to the meridian about 4m. earlier every evening, it is not likely to be seen even as a star after the middle of the month.

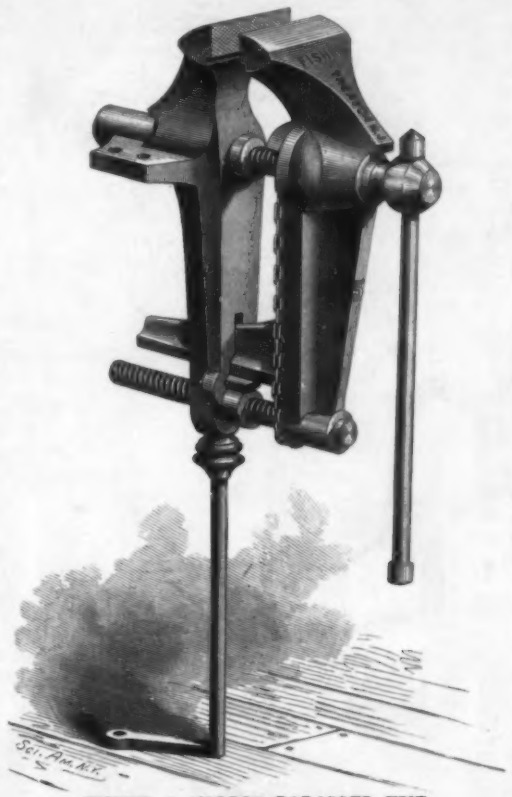
Proportions of Hulls, Engines, and Boilers of Yachts.

The following table, giving dimensions of hull and machinery as proportioned by a well known builder of steam yachts, contains particulars which will be of interest to many of our readers:

HULL.				ENGINE.				BOILER.		
Length over all.	Beam.	Draught.	Tonnage, carpenter's measurement.	Nominal horse power.	Diameter of cylinder.	Stroke.	Diameter of propeller.	Pitch.	Diameter of shell.	Height of shell.	Heating surface.
ft.	ft. in.	ft. in.	tons.		in.	in.	in.	ft.	in.	in.	sq. ft.
25	5 8	2 3	4	2	3	5	26	3	28	45	75
28	5 10	2 4	5	3	3½	5	28	3	30	46	90
32	6 4	2 6	6	4	4	6	30	3½	33	48	115
38	7 6	3 2	10	6	5½	7	36	4	36	56	170
50	9	3 6	16	10	7	9	42	5	46	76	246
60	10	4 2	26·5	15	9	12	48	5	50	82	332
68	11	4 8	37·5	20	10	12	54	6	54	86	402
75	12	4 10	43	30	12	12	56	7	60	90	504

DOUBLE SCREW PARALLEL VISE.

We give herewith an engraving of a new parallel "leg" vise, manufactured by Messrs. Fisher & Norris, of Trenton, N. J. The movable jaw of this vise is supported by an arm that passes through a mortise in the stationary one, and it is operated by two screws which are connected by an endless chain, each screw being provided with a chain wheel, so that when the upper screw is moved by the handle the lower



FISHER & NORRIS' PARALLEL VISE.

screw moves simultaneously with it, thereby insuring the parallelism of the jaws.

We are informed that the jaws are of the best tool steel welded on and properly cut and hardened, and that the screws and thread boxes are of the best refined iron, the latter being "solid cut." These vises are either with or without a swivel attachment.

NEW SAMPLE PACKAGE FOR THE MAILS.—A mail package, composed of tin, has been approved by the Postmaster General, for the transportation of samples of flour, bran, sugar, needles, nails, etc. The package has a clasp; there is no danger of its self-opening in the bags, while the contents can be readily inspected.

Correspondence.

The Supposed Volcano in the Moon.

To the Editor of the Scientific American:

The account, in your issue dated the 21st inst., of the supposed volcano in the moon, seen by Mr. John Hammes, calls to mind a theory I had some years ago, namely: meteors fall, of course, upon the moon as well as upon the earth, but the moon having no atmosphere, they reach its surface with their full cosmical velocity. If a meteor as large as some that have reached the earth should strike the moon the heat developed would turn the meteor to vapor, and an astronomer on the earth that chanced to have his telescope pointed that way would observe phenomena similar to those seen by Mr. Hammes. SAMUEL P. GARY.

Oshkosh, Wis., December 14, 1878.

A Fast Little Side-Wheeler.

To the Editor of the Scientific American:

In your issue of November 23, I was interested in the statement made by S. Firth, of Auckland, N. Z., in relation to his steam launch, and as my experience has been the opposite to his, in relation to vertical boilers, I thought it might be of interest to some of your readers.

I built a small side-wheel boat, 26 feet long and 5 feet 8 inches beam, flat bottom, with fine lines fore and aft, and depth of hull 2 feet. The paddle wheels are 4 feet 8 inches in diameter and 24 inches wide, being connected to engine by gearing—proportion, 5 to 1. The engine is horizontal, 4 inch bore and 6 inch stroke, cutting off at ¾ stroke. The average number of revolutions of engine is 300, with 100 lbs. of steam. The boiler is 36 inches high and 22 inches diameter, containing 91 flues 24 inches long by 1 inch diameter, and a fire box 18 inches diameter by 12 inches high.

I have raised 5 lbs. of steam in 20 minutes from cold water, and with anthracite coal, nut size. This boiler furnishes ample steam, with exhaust draught. The boiler never foamed any, excepting once or twice when first used, which was caused by oil being used in drilling holes for rivets, and considerable remaining inside.

This boiler performed so well that many have remarked its good qualities. Last winter the boat was lengthened 10 feet, and the wheels enlarged to 5 feet 8 inches diameter and 28 inches wide each. The boat draws 7 inches, and will carry 20 persons, drawing about 12 inches. She easily makes a mile in 8 minutes, and I think that compares well with many steam launches using the same power. Our river is shallow, which prevents our using a screw. Sometimes we can get only 14 inches of water in many places. In going through rapids we have used steam as high as 110 and 120 lbs., but never has the boiler failed in any particular.

I think the trouble with Mr. Firth's boiler was that it was too small for his engine. My experience inclines me toward the vertical boiler for this kind of purpose. I hope my experience may benefit others who can use only side-wheel boats. C. A. THOMPSON.

Owego, N. Y., Nov. 27, 1878.

Curiosities of Botany.

To the Editor of the Scientific American:

In the article on the "Proceedings of the Torrey Botanical Club," published in your issue of December 7, mention is made of a "full blown rose" from the center of which another perfect flower was growing. I wish to state that two roses were found last summer growing on the same bush, one having a cluster of five perfect buds raised on a stem from its center, and the other three.

A species of Allium was found in which the stamen, in a flower otherwise normal, was replaced by a bulblet; also in another flower one of the stamens was replaced by a perfect flower.

An ear of corn, which has grown wrong side out, is in my possession. The ear has the form of an inverted truncated cone, bearing the kernels on the walls of the hollow. The cob has a smooth exposed surface, and a texture somewhat more compact than the cob of normal ears.

Arkansas Industrial University, Fayetteville, Ark.

F. LEROY HARVEY, Prof. of Botany.

Pure and Unadulterated Baking Powders.

Believing that inestimable good will result to the public from the questions lately raised in the columns of your paper in regard to the healthfulness of certain articles used in the preparation of food, we think you will not hesitate to crown your efforts by pointing to goods of marked purity and reliability.

Cleveland's Superior Baking Powder, manufactured at Albany, N. Y., has, during the past nine years, gained a widespread popularity, and very many of your countless readers will be glad to know that it is approved and recommended for purity and healthfulness by such eminent chemists as the following:

NEW HAVEN, CONN., December 7, 1878.

Messrs. Cleveland Brothers,

911 and 913 Broadway, Albany, N. Y.:

This certifies that I have recently purchased of several grocers in this city packages of your "Superior Baking Powder," have submitted their contents to chemical analysis, and have found them to consist only of very pure and entirely wholesome materials, very suitably combined for this purpose. They contain no other acid than that of the purest grape cream of tartar, and are completely free from alum or any other deleterious or doubtful substance. They are, as to their composition, in all respects what you claim.

S. W. JOHNSON, Ph.D.,

Professor of Chemistry in the Sheffield Scientific School of Yale College; Director of the Connecticut Agricultural Experiment Station.

HOBOKEN, N. J., December 11, 1878.

Messrs. Cleveland Brothers, Albany, N. Y.:

I purchased a package of Cleveland's Superior Baking Powder of Messrs. Park & Tilford, in New York, and have made a careful analysis of the same. I find it to consist of pure cream of tartar, mingled with such other ingredients as render it an effective and desirable baking powder; and that it does not contain any alum, terra alba, or any adulteration whatever. It is, in my estimation, among the most wholesome compositions for a baking powder of which I have any knowledge. HENRY MORTON, Ph.D.,

President of the Stevens Institute of Technology.

NEW YORK CITY, December 12, 1878.

Messrs. Cleveland Brothers, Albany, N. Y.:

The results of a complete analysis on several packages of your Superior Baking Powder, purchased by myself of grocers in this city, confirm the fact that it is made of pure and healthful materials, well manufactured, and it is in every particular reliable and most wholesome. Having had the examination of the materials used in manufacturing your powder for many years, it affords me pleasure to recommend it without reserve. WM. M. HABIRSHAW, F.C.S.,

Analyst for the Chemical Trade of New York; Chemist of the New York State Agricultural Society; Analytical Chemist to the New York Produce Exchange.

WEST PHILADELPHIA, PA., December 7, 1878.

I have made a very careful analysis of "Cleveland's Superior Baking Powder," bought from grocers in this city, and have found it to be perfectly pure, and manufactured from the best quality of cream of tartar and other materials. It is entirely free from alum, acid phosphates, terra alba, and other substances which are frequently used for the manufacture and adulteration of baking powders; and on account of its purity and healthful constituents, deserves to be highly recommended. F. A. GENTH, Ph.D.,

Professor of Chemistry and Mineralogy in the University of Pennsylvania, Philadelphia, Pa.

PARIS EXHIBITION.

We give on this and the opposite page, four interior views of different departments at the Paris Exhibition. The first affords an idea of Belgian furniture and interior decorations; the second is the department devoted to telegraphy; the third, French upholstery and interior decorations, and the fourth is the department of carpets, tapestry, etc., in the French section.

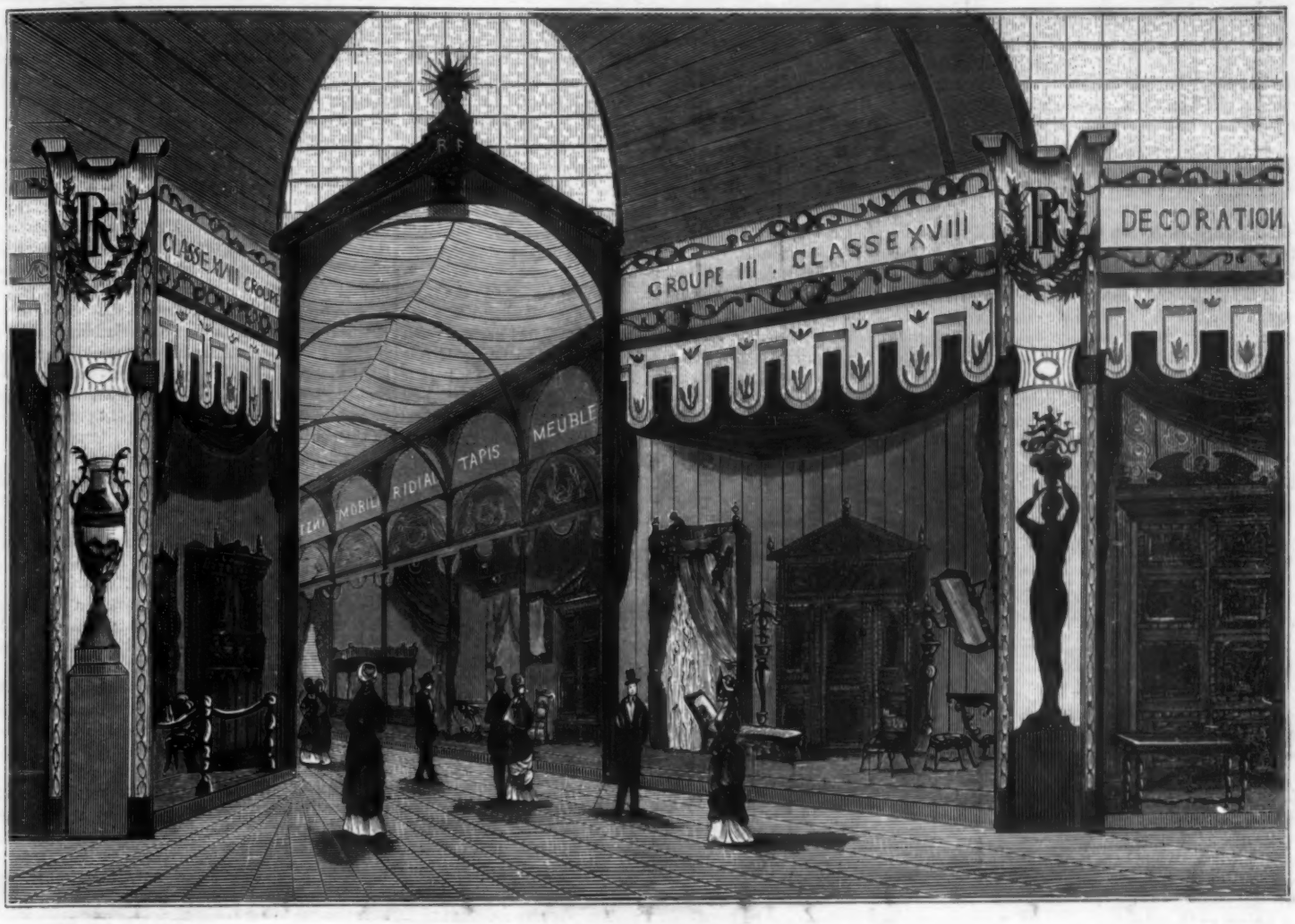
IMPERVIOUS RUBBER TUBING.—It is asserted that India rubber tubing may be made entirely impassable to coal gas by painting it over with a solution of silicate of sodium, otherwise known as "water glass."

BELGIAN FURNITURE AT THE EXHIBITION.

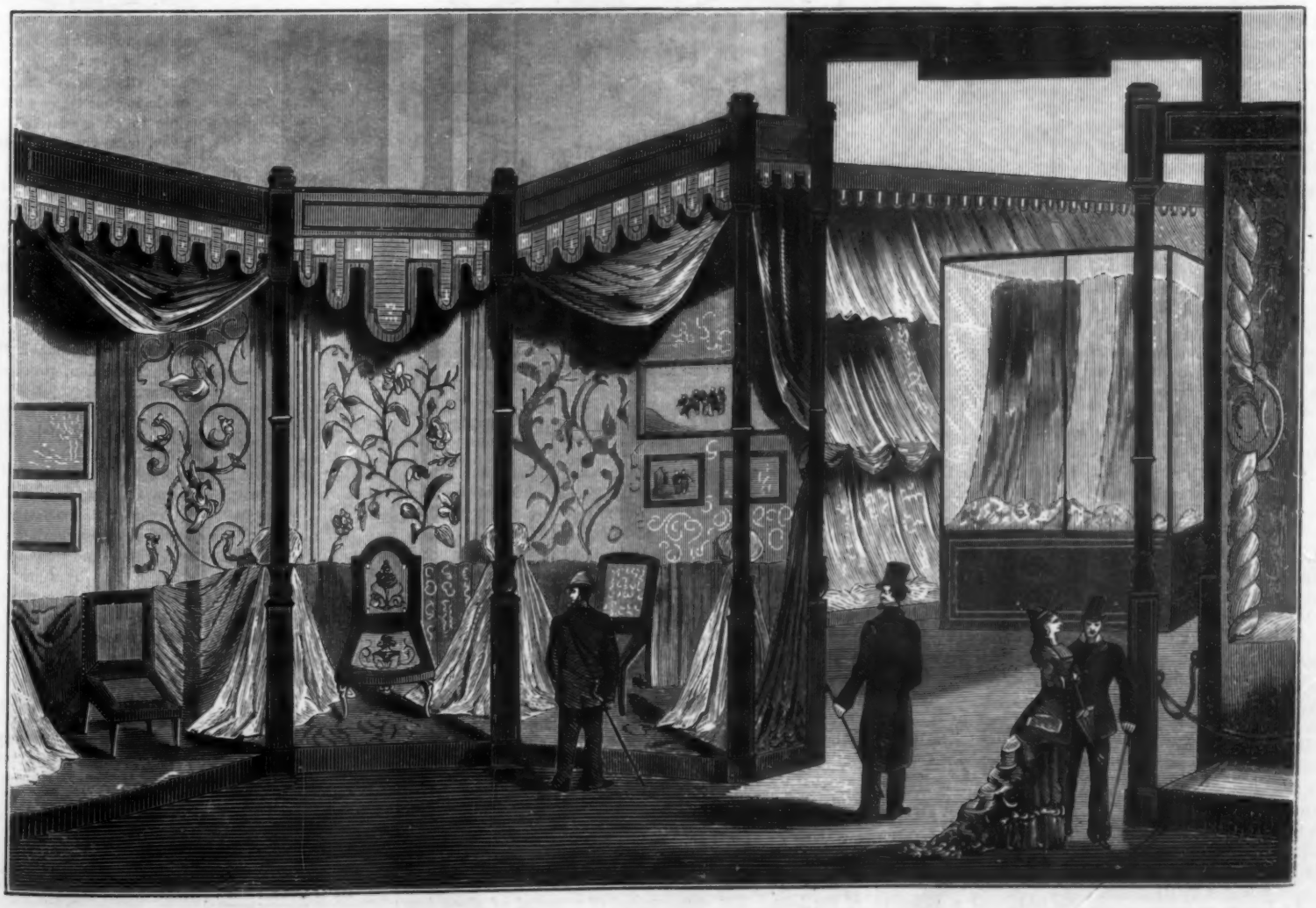
THE FRENCH TELEGRAPHIC ANNEX.

Asphalt Pavements.

Berlin has attempted to introduce asphalt pavements upon a few of her best streets. In some respects it seems of doubtful success. The roadway is very smooth and hard, pleasant to ride upon, and will prove a great saving in the expense for running stock, but also very expensive in the matter of horse flesh. When wet it is so slippery that few horses are able to traverse it with safety, and on every rainy day an immense number of loosely reined horses "take a tumble." The most recent victim was Herr Wachtel, the tenor singer, whose horses slipped, ran away, and Wachtel, attempting to jump out, was quite badly injured by his fall.



UPHOLSTERERS' AND DECORATORS' WORK, FRENCH SECTION.



CARPETS, TAPESTRY, ETC. FRENCH SECTION.

VIENNA BRONZE WORK.

Great exertions were made by the Austrian manufacturers, not only to make a fine display at Vienna, but also to carry off at Amsterdam the special prizes offered by the Dutch authorities for the best designed articles admitted to the international competition.

Among those who contributed choice specimens was Hollenbach, of Vienna, whose bronze work attracted no little admiration.

One of the finest examples of M. Hollenbach's work, a flower vase in gilt bronze, is shown in the accompanying engraving.

Promised Revival of Sodom and Gomorrah.

It is reported that French capitalists have secured a grant for a railway line from Jaffa to the interior of Palestine, which will open up the Jordan valley and the whole region north of the Suez canal. In certain contingencies this road might become of great military usefulness, but it appears further that the productive resources of the country are considerable, and what is more surprising, that the Dead Sea itself can be turned to commercial account. Chief of these at present are the stores of natural combustibles for which that region is noted.

Hitherto the main obstacle to the development of steam traffic in the Levant has been the total absence of combustible material. Not only Egypt, but the shores of Syria and the Red Sea are completely stripped of wood, and the coal imported from the West commands a price ranging from $10 to $24 a ton. Now the masses of asphalt continually thrown up by the Dead Sea attest the presence of vast subterranean layers of fossil vegetable matter, and these signs were not long overlooked by the enterprising men attracted to Suez by the opening of the canal and the movement of commerce in that direction. Recently numerous soundings have been made between Jaffa and the Dead Sea, which, so far, have not disclosed any deposits of coal proper, but, on the other hand, have laid bare inexhaustible beds of lignite.

Of itself this store of lignite is likely to prove an inestimable gain to the industries and commerce of the Levant; but we should add that the juxtaposition of asphalt in great quantities furnishes the elements of a mixture of lignite and asphaltum in the form of bricks, which is equal in heating capacity to the richest bituminous coal, while its cost on the ground is only $2.50 a ton. It is known that similar bricks, made up of coal dust and bituminous debris from gas works, are much sought after by French railways, since, besides their heating power, they greatly facilitate stowage, owing to their regular shape. Of course the bitumen of lower Palestine has been known from immemorial times, and was used to impart solidity to the structures of unbaked clay in Assyria and Egypt; but it may be said that the discovery of the subterranean combustible has lifted once for all the curse which has so long rested upon Sodom and Gomorrah, and will transform the wasted shores of the Dead Sea into a focus of industry and a magazine of wealth.

VIENNA BRONZE WORK.

New Mechanical Inventions.

An improved Wrench has been patented by Mr. William R. Leeson, of Bridgewater, England. This invention relates to adjustable spanners or monkey-wrenches, and consists in a sort of toggle bar applied between the movable jaw and the shank or handle so as to cause the latter to be firmly gripped, so that when pressure is applied to the jaw in a direction tending to open or move it away from the fixed jaw the grip becomes tighter.

An improved Mechanical movement has been patented by Mr. David E. Cripe, of North Manchester, Ind. The object of this invention is to furnish an improved device for use upon all machinery where a rectilinear motion is converted into a rotary motion, and to prevent the machinery from stopping with its crank upon a dead center, so that the machinery can always be started by the movement of the driving pitman.

An improved Fan Attachment for Sewing Machines, etc., has been patented by Mr. James W. Chambers, of Baltimore, Md. A standard is clamped to the table, and a socket to receive the fan handle is pivoted to the standard, and is vibrated by the conjoint and alternate action of a spiral spring and a flexible cord attached to the machine.

The Drainage of Lake Fucino.

The opening lecture to the class of Civil Engineering, at the University of Edinburgh, was lately given by Professor Fleeming Jenkin. The Professor gave an account of the great project for draining Lake Fucino, in Italy, which, commenced 2,000 years ago, had at last been successfully accomplished. The lake was situated in the Abruzzi province, 53 miles east of Rome, and covered the greater part of a large table land near the small town of Avezzano. The surface of the water was 2,094 feet above the sea, but to the lake there was no natural outlet; and though the action of the wind on the water prevented it from stagnating, the neighborhood of the lake was very unhealthy. Whenever there was a succession of years in which the rainfall was heavy, the lake rose enormously, and covered the adjoining country. The nearest river was the Liris, 3¾ miles away, but the mountain Salviano and a high plain separated the two. The comparisons between what the lake was recently and what it had been in ancient times, were extremely curious, as showing the changes which took place in the rainfall over a long cycle of years. Between 1783 and 1816 the lake rose 30 feet 5 inches, and was then 74 feet deep. From the commencement of 1820 to 1835 it fell to nearly 11 feet below its level in 1783, being then 31 feet deep. In 1861 it had risen again 30 feet. The remains of drainage works on the lake showed that its area was about the same in 1816 as it was in the reign of Julius Cæsar or the Emperor Claudius; though there was evidence that it had risen much higher in prehistoric times. The average extent of the lake was 33,050 acres. It was 12·4 miles long and 6·8 miles broad. The Italian engineers calculated that the lake had been silting up at the rate of 12 inches per century—and that was an interesting geographical fact, as showing the rate at which these large lakes silted—so that the present bottom was 15 feet higher than it was in the reign of the Emperor Claudius. Julius Cæsar had conceived the utility of draining the lake for the sake of the health of the district, and also with the view of increasing the corn growing area near Rome; but his death put an end to the scheme. In the reign of Claudius the project was again revived, and the favorite Narcissus was ordered to go on with the necessary works at the public expense. Suetonius stated that for eleven years 30,000 men were employed there, and the elder Pliny said that the works were so extraordinary that no language could give any idea of them. These works consisted in boring a tunnel under Mount Salviano, 984 feet below its summit, and under the Palentine fields at an average depth of 328 feet to discharge into the river Liris the surplus water of the lake. The construction of a tunnel of about four miles in length at a great depth under a mountain was, in the then state of engineering science, a wonderful undertaking. It would not be an easy job now. The tunnel actually was made, and the lake partially drained; and it appeared from the remains of the old tunnel that the original engineer understood his work well, but that the designs were imperfectly carried out, and the work shockingly scamped by the contractor. First of all, levels could not have been well understood in those days; nevertheless, the outfall had been most correctly chosen, so as to give the reasonable fall to the water of 1⅛ in 1,000; the new outlet at the river Liris was within a foot or two, and at the same level as that chosen by the Roman engineer, and the Roman engineer had also selected the direction of the tunnel very properly, and had followed so correctly the configuration of the ground in making it that the modern engineers had not been able to improve upon it. The old shafts—40 in number—which had been sunk so that headings might be driven in various directions at one and the same time, had been well constructed, and had been largely taken advantage of in constructing the modern tunnel. A great difficulty the Romans must have encountered was the quantity of water which flowed from the strata; and how they got over it was not easy to say, as it was not known that they had pumps sufficient to cope with large accumulations of water. One of the most curious things about the old tunnel was the constant variation of the cross sections. Beginning with a finely arched entrance, the tunnel as it went into the hill got smaller and smaller, just as the men got tired of the work, until in the center there was only a hole large enough for a man to creep through. Then it opened out again toward the outfall. Where it could be inspected it was all right, but what was altogether out of sight had been scamped in the way indicated. During the progress of the work a great slip had occurred; and evidently, as they could not get through the loose earth, the workmen turned off to the right and made a curved gallery through the stone, some 400 feet in length, round the obstructing mass. The tunnel was opened by Claudius, who first of all witnessed a sanguinary sham sea fight on the lake, in which the convicts, gathered from all parts of Italy, were made to destroy each other. The tunnel, however, soon got blocked, and it was not until Hadrian's time that it was put right. The lake was then reduced to some 17,000 acres. The entrance to the tunnel seemed to have been kept in good order down to the 5th century, but with the fall of the Roman Empire the tunnel was abandoned and the lake resumed its ancient extent. Various abortive attempts were afterward made to open the tunnel from time to time. In 1851 a company, with a capital of £200,000, was formed for draining the lake—the concession they were to get in return being land which was reclaimed; but this enterprise, too, fell through. Prince Alexander Torlonia, who held half the shares in the concern, however, bought up the other half, and having obtained the repeal of some objectionable clauses in the concession, proceeded with the work.

He consulted a French engineer, Franz Mayu de Monsucher, under whose direction a tunnel, following the line of the old one, for carrying off 11,000 gallons of water per minute from the lake, was completed in June, 1875. The cost had been £1,750,000 sterling. The lake had now been completely drained, Torlonia had got an estate of 35,000 acres, the neighborhood was now healthy, and the general prosperity which had been brought about to the population, by this great work, had been most marked.

Trial of Brainerd's Exhaust Pipe.

Brainerd's patent variable exhaust pipe, which we illustrated on page 262, vol. xxxviii., has recently had a trial on one of the engines of the Grand Trunk Railway, Canada. Four trips were made under similar circumstances, two with the Brainerd exhaust and two with the ordinary nozzle. The following table will give an idea of the comparative value of the two nozzles:

	Brainerd's exhaust.	Ordinary nozzle.
Total weight of train in pounds	1,639,150	1,590,400
Total weight of coal burned in pounds	10,305	11,388
Total weight of coal burned in pounds per mile	4,560	5,033
Total weight of coal burned in pounds per ton of load per mile	115	125
Pounds of water evaporated	73,111	72,308
Pounds of water evaporated per pound of coal	7·09	5·01
Maximum steam pressure	135	135
Minimum steam pressure	110	120
Average steam pressure	124·5	130·5

Notes & Queries

(1) J. L. J. asks: What composition for steam valves and cocks will expand the least? A. The following composition answers well: 20 parts, by weight, copper; 3 parts by weight, zinc; 3 parts by weight, tin.

(2) J. N. B.—We know of no work especially devoted to nickel plating. You will find a comprehensive article on nickel plating on p. 209, vol. 38, SCIENTIFIC AMERICAN.

(3) A. R.—You will find a receipt for cementing rubber on p. 230 (15), vol. 38, SCIENTIFIC AMERICAN.

(4) J. R.—No reward has been offered for perpetual motion.

(5) J. R. M.—Lepidolite is found at Hebron, Me., and near Middletown, Conn. It has about the following composition:

SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	RbO	LiO	NaF	K	H_2O
50·32	28·54	0·73	0·51	1·01	0·24	0·7	1·77	9·6	3·12

Stillman has lately shown several lepidolites to contain cæsium—one sample from Bonn, Prussia, contained as much as 0·68 per cent, CsO.

(6) M. M. asks for the best method of cutting glass tubes used for water gauges. A. File in one side a slight notch; upon the opposite side place the two thumbs with ends of nails exactly opposite the notch; now grasp the tube with both hands and pull lengthwise on it, while you break it as you would a stick.

(7) J. H. A. G. asks how many cells of a Calland battery are necessary to heat a short strip of platina foil ¹⁄₁₀ of an inch wide and ¼ of an inch long, hot enough to explode gunpowder? A. Eight.

(8) W. E. K. asks: 1. What quantity and size of wire shall I use for an electro motor? A. This depends on the kind of battery used, as there exists a certain relation between the resistance of the magnet coil and that of the battery. Where a quantity battery is used the wire may be larger than when the battery is arranged for intensity. 2. I have straight soft iron cores ¾ inch in diameter, eight in number; I calculate to use both ends of the cores if possible: the cores will be about 4½ inches in length; would such an arrangement generate any power for propelling light machinery? A. Yes, but U-magnets would be better. 3. What size wire is generally used for winding the permanent magnets of dynamo-electric machines, and also what size for winding the electro-magnets? A. Where permanent magnets are used they are not wound. When electro-magnets are employed, the size of wire varies greatly with the use to which the machine is applied; the same is true of the armature.

(9) S. D. C. asks: 1. How many pounds pressure will a boiler stand which is made of heavy tin, 10 inches diameter, 15 inches high, having 7 or 8 1¼ inch tubes? A. Safe working pressure, 15 to 20 lbs. per square inch. 2. Give directions for making a good machine which will furnish sufficient electricity to produce an electric light, said machine to be run by a small engine. A. See SCIENTIFIC AMERICAN SUPPLEMENTS Nos. 17 and 151.

(10) W. H. A. asks: 1. What is the weight of a United States gallon of water, and how many cubic inches in it? A. 8·33 lbs., 230·8 cubic inches. 2. What material will fit a piston in a cylinder water tight, so that when working the amount of friction shall be as small as possible? A. Any hard metal, accurately fitted. 3. Does it take as much power to raise a piston (fitting air tight in a cylinder) with water standing under it so that the water will rise as piston rises, as it requires to form a vacuum beneath piston? A. Yes.

(11) W. S. L. asks: 1. What size of copper wire gives the best effect in an electro magnet, such as is used in the De Meritens machine? A. For a small machine we think No. 14 or 16 would do. 2. Can the wire be purchased already covered, and where? A. From dealers in this city who advertise in our columns. 3. Is the effect the same if the permanent magnets are revolved instead of the electro-magets? If so, it would seem as if the wear of brushes, springs, or commutations, would be avoided by this plan. A. Permanent magnets lose their magnetism by jarring; it is, therefore, best that they should remain stationary. 4. Will steel wire bent into proper shape, hardened, magnetized, and wound into a bundle, magnet shape, make a magnet equally powerful with a compound plate magnet as used in the De Meritens machine? A. We think not, but it might answer very well. 5. Can the magnets be made with a set of bar magnets? A. Yes. 6. Will cotton do for covering for the wire? A. Yes. 7. Have you a recent work on the subject of Magneto-Electricity and the Electric Light? A. We intend publishing papers on these subjects at an early day in the SCIENTIFIC AMERICAN SUPPLEMENT.

(12) T. S. M. asks which will consume the most power, to place the driving pinion in a hoisting machine above or below the center of the large spur wheel? A. We think it will make no difference.

(13) G. E. F. asks: 1. How to make or mix the substance used in cold water pens. A. Mix any of the soluble coal tar dyes with gum water to form a thick paste, and after filling the case, dry at a gentle heat. 2. Also a good mucilage. A. Triturate 1 ounce of gum arabic with about 4 fluid ounces of hot water in a mortar, and add a few drops of clove oil. Or make a solution of dextrine in about 3½ parts of boiling water.

(14 W. E. G. asks what would be the power of an engine 2 inches bore and 4 inches stroke. Will an oscillating engine of the same size produce the same power with the same amount of steam, say 60 lbs.? What size should a boiler be for such an engine? Would an engine of this size run a lathe that swings 12 inches for turning iron? A. There will be no difference in the power of the two engines, if properly constructed. To determine the horse power, multiply together the mean pressure during stroke in pounds per square inch, the area of the piston in square inches, the length of stroke in feet, and twice the number of revolutions per minute, and divide the product by 33,000. Make a boiler whose heating surface is in the proportion of from 15 to 20 square feet per horse power. The engine can be used to run the lathe.

(15) J. F. S. writes: I am about to select a trade or profession. I have a taste for mechanical trades of all kinds, farming and mercantile business. I have a chance to go as runner in a bank in New York, or to go on a 400 acre farm in Indiana. 1. Which shall I do? A. Go on the farm by all means. 2. How can I distinguish oleomargarine butter from the genuine article? A. According to Professors Sechartier and Taylor, oleomargarine may be distinguished from pure dairy butter by examining a sample under a good microscope. The latter presents a nearly uniform color; the forms seen consist of oil globules and crystals of salt. When observed by polarised light very little change is observed, but if the specimen contain oleomargarine the field is speckled over with shining particles which change color with every quarter turn of the analyzer. A power of 75 diameters exhibits these changes very markedly. With a power of 250 diameters more or less animal tissue may usually be detected.

(16) H. S. asks how to solder German silver. I have tried what they call silver solder, with a blow pipe and a spirit lamp; the solder will not melt. A. Rub a lump of borax with a drop or so of water on a common slate or porcelain slab, until a thick paste is produced. Clean the surfaces to be soldered and paint on the borax paste; dip your silver solder in the borax paste and place it in position on the work. Pin the work on a charcoal or piece of pumice stone, with common tacks (not tinned), direct the reducing flame of a blow pipe upon the work until it becomes red hot, then project it on the solder. The small silver three cent pieces make excellent solder for German silver, brass, copper, iron, and steel. SCIENTIFIC AMERICAN SUPPLEMENT No. 20, contains full practical directions for soldering.

(17) J. S. writes: I have a quantity of lard oil that I think contains salt or acid. How can I test it? A. If the oil contains pure acid, a scrap of blue litmus paper rubbed with it will indicate the fact by turning red. A notable amount of salt is readily detected by taste. A little hot water will extract salt from the lard, and a drop of nitrate of silver solution (aqueous) added to the clear water from the oil will occasion a white curdy precipitate, if salt is present even in very small quantity.

(18) A. A. asks: 1. How many Bunsen cells of such size as could be made in a common glass tumbler would it take to furnish electricity enough for an electric light to light a room twenty feet square? A. About 100. 2. How many of capacity of 1 quart for glass jar? A. 50. 3. What is the size of jar most suitable for battery for electric light? A. One quart. 4. Would porous cells made of fine potter's clay of proper size and shape be suitable? A. Yes. 5. Is a glazed earthen jar as good as glass for outer jar? A. Yes. 6. Are common plant jars as good for porous cups as those made of finer and more compact clay. A. No.

(19) A. C. F. asks what size of steam pipe to use for an engine 8 inches x 10 inches stroke, running at 180 revolutions per minute at 60 lbs. pressure. A. A pipe 2 inches in diameter will answer.

(20) C. A. W. asks: Is the effect of the shock from an induction coil good or bad upon the body in good physical condition? A. Strong electrical shocks are injurious.

(21) J. C. F. asks: 1. In damping the diaphragm of phonograph described in SUPPLEMENT No. 133, do you simply cut small pieces of rubber tubing and place on the diaphragm? A. Short pieces of rubber tubing are placed between the diaphragm and its support, and are allowed to exert a slight pressure on the diaphragm. 2. Will fine copper wire insulated with gutta-percha do for the coil in a telephone as well as silk covered? A. The gutta percha covering is generally too thick; silk covered is preferable.

(22 W. D. S. asks: 1. In the best kind of safety valves for steam boilers does the area for escaping steam gradually increase as the pressure increases? A. According to experiments made by the United States Boiler Inspectors, common safety valves, when properly proportioned, are as efficient as those which give an enlarged area for increased pressure. 2. Are the air compartments in ships' rooms done off for floating power alone, or are they sometimes used for storage? A. The compartments having doors are ordinarily used for storage. 3. Would an invention be valuable that would automatically close the doors between the air compartments without any machinery in case a hole was made in the vessel below the water line? A. We think it quite likely, if superior to the arrangements in use.

(23) W. A. M. writes: I have a bottle of pure bay oil, will you please inform me how I can make bay rum suitable for toilet purposes? A. 10 fluid drachms of oil of bay rum; 1 fluid drachm of oil of pimento; 2 fluid ounces of aceticether; 3 gallons of alcohol 95 per cent; 2½ gallons of water; mix, and after two weeks' repose, filter.

(24) G. C. asks: What is the best method of protecting the lungs against dust while sweeping? A. Breathe through a moistened sponge.

(25) E. G. McD. asks how to make marking fluid for the backs of Brussels carpets. A. An excellent ink for this purpose is prepared by triturating 4 parts of powdered soluble nigrosine in about 15 parts of hot water, and straining the hot solution repeatedly through fine silk or filtering through filter paper, using a hot funnel. See also inks in SCIENTIFIC AMERICAN SUPPLEMENT No. 157.

(26) Engineer asks which of the two is the largest—the Cincinnati water works, or the new water works about completed at Pittsburg, also their relative capacities. A. Perhaps correspondents from these localities will kindly send us particulars.—ED.

(27) W. Z. B. asks: 1. Can water be forced into a boiler above the water line? It may not be advisable, but can it be done? A. Yes. 2. Our office is heated by coils of pipe which drain themselves completely, where they, and their outlets, are subject to no other pressure than that of the atmosphere. If both outlets are connected to the dome of a boiler carrying 60 lbs. of steam, placed below these outlets, will the pipes still drain themselves? A. Yes, if there is sufficient fall, and the pipes are properly arranged. 3. Our water works give a pressure of 125 lbs. to the inch. If a pipe was connected from the main to the dome of a boiler carrying 60 lbs., would water enter the boiler? A. Yes.

(28) W. asks: 1. Will steam or water deposit scale when not coming in contact with heated surfaces? A. Water may do so. 2. Will steam when not superheated cause oxidation of brass? A. To some slight extent.

(29) T. D. H. says: 1. I have a telegraph line about 300 feet, No. 14 copper wire, gas pipe grounded, and on it are two learners' instruments and two bells (box pattern). How many jars will I want of Lockwood or Watson batteries to work it? A. Four. 2. What is the comparative strength and usefulness on a line of these two batteries? A. There is not much difference. 3. If an office ground both line and local on one binding post, and thence by one wire to the ground, is there any danger of a return current if one be grounded and the other in use? A. No. 4. What will take knot and dust marks (from cracks) out of an engraving? A. Moisten the parts thoroughly with soft water, and press strongly between hot sheets of bibulous paper. When cool moisten with strong cold solution of fresh sodium hypochlorite, and when sufficiently clean, moisten again with a little sodium hyposulphite solution, and, after a time, absorb excess of moisture with clean blotting paper, and press between sheets of the same with hot irons until perfectly dry.

(30) W. S. D. writes: 1. I have made a steam engine cylinder 1¼x2 inches; now I want a boiler, can I get steam enough by using a boiler on a common cook stove—boiler to be about 8 inches in diameter made of cast iron? I want it to run a bracket saw on large work. If this will not do, how can I generate sufficient steam? Of what can I make a boiler; and how large? A. If you set the boiler in the fire, you can probably make enough steam. It would be better to form it of copper, from 8 to 10 inches in diameter. 2. Is cold rolled iron as good as steel for piston rods, arbors, etc? A. It is not as strong, comparing good qualities of each. 3. How shall I temper machine steel to have it the toughest? A. You can make the steel very hard, by heating it and plunging into cold water. After this, you can temper to any less degree of hardness, by reheating, and allowing it to cool somewhat, before plunging into cold water.

(31) E. W. T. asks: What form would be the best to copy to make a small magneto-electric machine, costing from $8 to $10? I want a continuous current for physiological experiments. A. Probably Clarke's machine would be best for your purpose, but we do not think you can make one for the price named.

(32) J. G. A. and C. K. will find receipts for ebonizing woods on pp. 191 (19), 219 (67), and 251, vol. 38, SCIENTIFIC AMERICAN.

(33) W. B. S. writes: In heating our factory we take steam from the steam dome, and the return or drain pipe into the heater then (after the pipes are heated up) turned into the mud drum. It seems there is enough greater pressure at the mud drum to prevent the return water from flowing back into the boiler by a head of about eight feet or more generally. How can this be remedied? A. Ordinarily, this is not enough head to secure good circulation, in an extensive system of radiators, unless all the return pipes can lead with a fall into a vertical main. Fortunately the difficulty can be easily solved by adding a good trap.

(34) S. G. B. asks if there is a difference between one "square foot" and one foot square. A. Square foot is the more comprehensive term, since it includes the "foot square" (*i. e.*, a square one foot each way) and all other figures having the same area, 144 square inches. The first is a unit of measure, without regard to form; the second is a particular form of a particular size.

(35) A. G. L. asks: 1. Is there anything that will prevent kerosene oil from smoking when used for cooking purposes? I used three tubes similar to those used on torches, but a black deposit soon formed on the bottom of the kettle. A. The burner for a kerosene stove should be made on exactly the same principle as a first class lamp burner. 2. Can I make the electric light by using a battery composed of zinc and copper plates immersed in solution of 9 parts water, 1 part sulphuric acid, the plates being 3 x 4 in., ¼ in. thick; how many cells would be sufficient? A. 50 such cells would produce a light, but not for a great length of time, as a battery of this kind is not constant. 3. What size copper wire is best for connections? A. No. 12 or 14. 4. When I melt zinc in an iron ladle it is brittle; is it fit for battery plates? A. Yes.

(36) R. W. S. asks: If a malleable iron casting ¼ of an inch thick by 2½ wide, is securely held at each end by a solid support, so that there is two inches of unsupported metal between the supports, what pressure in pounds brought to bear upon the center of the casting will break it? A. Trantwine gives the following rule: Breaking weight in pounds

$$= \frac{(\text{Depth in inches})^2 \times (\text{Breadth in inches})}{\text{Clear length in feet}} \times 4200$$

This rule is for the case in which the ends are immovably fixed.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

S. F.—It is a micaceous sand. Not valuable. We could not indicate the probable value of the stone from your description alone.—J. G.—It is magnetic iron sand—magnetic iron oxide or magnetite. It will make an excellent quality of iron if properly smelted. It may be freed from sand and other impurities by means of large magnets.—J. B.—The light colored specimens are principally marcasite (an iron sulphide), with traces of copper and arsenic, in slate. The other sample contains a large per cent of lead (galena) and chalcopyrite (iron copper sulphide). The ore will probably prove of value.—J. T.—The quartz contains galena (lead sulphide) and a little chalcopyrite and zinc. The property is doubtless of some value.

COMMUNICATIONS RECEIVED.

The Editor of the SCIENTIFIC AMERICAN acknowledges with much pleasure the receipt of original papers and contributions on the following subjects:

Wagon Wheel Problem. By M. S. C.
On Subdivision of Electric Current. By J. T. P.
Metric System. By R. F.
Facts and Figures for Mathematicians. By L. S. B.
Electric Light Telegraph. By F. P.
Acoustic Telephone. By E. D. V.

Any numbers of the SCIENTIFIC AMERICAN SUPPLEMENT referred to in these columns may be had at this office. Price 10 cents each.

HINTS TO CORRESPONDENTS.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Many of our correspondents make inquiries which cannot properly be answered in these columns. Such inquiries, if signed by initials only, are liable to be cast into the waste basket.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

[OFFICIAL.

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were Granted in the Week Ending

November 5, 1878,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A complete copy of any patent in the annexed list, including both the specifications and drawings, will be furnished from this office for one dollar. In ordering, please state the number and date of the patent desired, and remit to Munn & Co., 37 Park Row, New York city.

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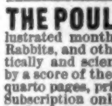

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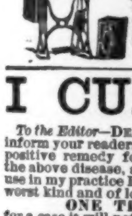

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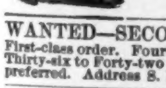

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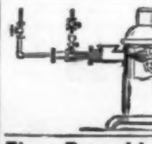

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